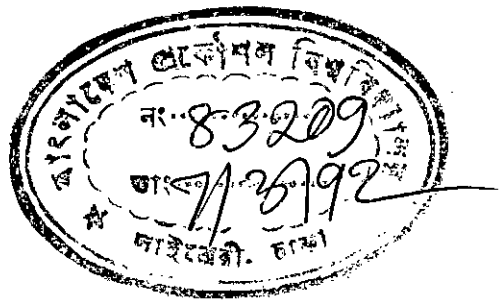
ERGONOMIC ANALYSIS AND DETERMINATION OF MANPOWER REQUIREMENT IN A CHEMICAL PRODUCTS MANUFACTURING PLANT

A Project Thesis

By

MOHAMMED AYUB SARDER



Department of Industrial and Production Engineering
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Dhaka, Bangladesh

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A Project Thesis submitted to the Department
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C E R T I F I C A T E

This is to certify that this work has been done by me and it has not been submitted anywhere for the award of any degree or diploma or for any publication.

Supervisor

The Author

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ABSTRACT

Most of the Chemical Products Manufacturing Plants in Bangladesh are loosing concerns due to competitions they are facing from the similar private sector enterprises. It is believed that one of the main reasons for such failure is the absence of proper utilization of resources and manpower.

A study was conducted in Kohinoor Chemical Company (Bangladesh) Limited, an old organization of Bangladesh Chemical Industries Corporation. The production lines, manpower and production methods were set long before. It was not possible for the management to apply latest possible tools and techniques to determine manpower requirement and working methods. Standards of production were not set properly. Over the years different work procedures came into practice.

The main objective of this research was to carry out an Ergonomic Analysis for the cosmetic and soap processing plants of KCCL and determine the manpower requirement to improve productivity. In conducting this study the basic principles of (a) Production Method Study, (b) Work/Activity Sampling Technique, (c) Time and Motion Study and (d) Ergonomics Methodology were utilized.

From the Production Method Study and Ergonomic analysis, various improved/modified production methods and layout and applications of ergonomics on the design of existing work places, handling loads, hand tools and devices, working environment and motion economy were suggested. From Work Sampling and Time Study technique the required manpower requirement was determined. It was found that about 37% and 48% excess manpower were being used in cosmetic and soap processing plants respectively. It was also found that about 41% and 44% less production were being produced in cosmetic and soap processing plants respectively.

It was suggested that the application of the present investigation will contribute in improving in productivity and profitability of this enterprise.

LIST OF ABBREVIATIONS

ACE(M)	:	Additional Chief Engineer (Mechanical)
AE(M)	:	Assistant Engineer (Mechanical)
AIT	:	Asian Institute of Technology
BCIC	:	Bangladesh Chemical Industries Corporation
BUET	:	Bangladesh University of Engineering and Technology
BMDC	:	Bangladesh Management Development Centre
CBA	:	Collective Burganing Agent
CIS	:	International Occupational Safety and Health Centre
DCE(M)	:	Deputy Chief Engineer (Mechanical)
GM	:	General Manager
HST	:	High Skilled Technician
ILO	:	International Labour Organization
IWW and PC	:	Industrial Workers Wages and Productivity Commission
IPE	:	Industrial and Production Engineering Department
JFCL	:	Jamuna Fertilizer Company Limited
KP	:	Kilopond (an old unit of force, = 1 kg force)
KCCL	:	Kohinoor Chemical Company (Bangladesh) Limited
KBML	:	Kohinoor Battery Manufactures Limited
MD	:	Managing Director
MTS	:	Maintenance and Technical Services
MMH	:	Manual Material Handling
MNSP	:	Modified New Scales of Pay
PGDIM	:	Post Graduate Diploma in Industrial Management
SMS	:	Standard Minutes
ST-I	:	Skilled Technician Grade One
ST-II	:	Skilled Technician Grade Two
SST	:	Semi Skilled Technician

Chapter – I

I N T R O D U C T I O N

1.1 BACKGROUND

It has taken a long time for industries to fully recognise the extent of interdependence between working conditions and productivity. The first move in this direction began when management started to realise the ultimate effect of occupational accidents and diseases.

Working condition and improper way of handling jobs have great effect on productivity. Research studies have shown that human bodies are very productive under optimal working condition. The effects of health and safety on productivity can not be properly discussed without the concept of ergonomics. The last of ergonomics is to develop the most comfortable conditions for the worker as regards to workplace and posture, lighting, climate, noise, vibration, humidity, etc. to reduce the physical work load.

There are many Chemical Products manufacturing plants in Bangladesh under public and private sector. These industries play a great role in industrial sector of the country. BCIC is the largest Chemical Corporation in Bangladesh under public sector. There are about 23 (twenty three) Chemical

Products Manufacturing Enterprises under BCIC. Some of them are profitable while others are loosing concerns. KCCL is one of them which are enlisted as loosing concern enterprise. The authority has been concerned with the productivity of this plant. Therefore it was decided to conduct an ergonomic analysis of the plant with the aim to increase its productivity and thus to help KCCL to go one step forward towards a profitable organization.

KCCL produces different kinds of soap, detergents, cosmetics, etc. The products of cosmetic section are: Tibet snow, Tibet Tooth Paste, D-5 Tooth Paste, D-5 Gel Tooth Paste, Tibet Shaving Cream, Honey Dew Shaving Cream, Tibet Pomade Cream, Tibet Powder, Various types Hair Oil, Tibet Chandan Atar, Tibet Perfume, etc. The products of Soap Section are: Tibet Blue Bar, Tibet 570 Washing, Tibet Ball, Tibet Bar, Tibet Toilet Soap, Lemon Dew, Tibet Flora, Tibet Glycerine Soap etc.

To conduct the study smoothly, is a befitting manner the entire cosmetic manfuacturing process was divided initially into two major groups and then one of those groups was sub-divided into two sub-groups. Snow, Tooth Paste and Shaving Cream which are being marketed in tube are in one group and Snow, Cream (Pomade) which are being marketed in bottle are in another group. The base manufacturing process of these items are same. Only mixing, filling and sealing procedures are different. The other group is powder section. Here the

manufacturing process as well as mixing, filling, sealing and packing procedures are different from the other two groups.

Among other products soap is a main item of this factory. The Soap Processing unit is divided into three plants for the current study purpose which are as follows:

i) Plant P1/P2 for blue bar soap production
ii) Plant P3 for toilet soap production
iii) Plant P4 for 570 washing soap production.

The study was confined only in the above P1/P2, P3 line of Mazzoni plant and P4 line of soap processing unit. Soap is manufactured in full boiled procedure in KCCL. Out of several types of soap 570 and blue bar are marketed as loundry soap and Tibet, Sandalina, Glycerine are marketed as toilet soap. Glycerine soap is manufactured in different sheds in different procedures. After mixing melting tallow, salt, coconut oil and other ingredients are pumped in saponification cattle. This is knwon as soap boiling unit. Neat soap is pressurised after washing, resting and removal of glycerine. Neat soap is fed to soap processing plant as per requirement of production. The finished product is produced in this plant. Manufacturing and packing of soap is done in the soap processing plant in semi automatic manner.

This study was under taken to ergonomically analyse the work methods and working conditions and hence to determine the manpower requirement for the present production level of cosmetic and soap manufacturing plants to improve its productivity.

1.2 OBJECTIVES OF THE STUDY

The main objectives of the study were:

a) To study the present work method and working conditions and to suggest a better method of work by applying ergonomics and method study.

b) To apply Time and Motion Study and Activity Sampling in determining standard time of each job and manpower respectively.

c) To calculate manpower requirement on the basis of Time Study through production line balancing.

d) To determine expected output by existing manpower through Time Study method.

e) To suggest some applications of ergonomics in cosmetic and soap processing plants in KCCL considering human abilities, characteristics, expectations, motivation and behaviours in the design of the things workers use in their work places.

Chapter – II

LITERATURE SURVEY

2.1 WORK STUDY

Work Study is a generic term for those techniques particularly method study and work measurement, which are used in the examination of human work in all its contexts, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed in order to effect improvement (5).

Work study therefore has a direct relationship with productivity. It is most frequently used to increase the amount produced from a given quantity of resources with little or no further capital investment.

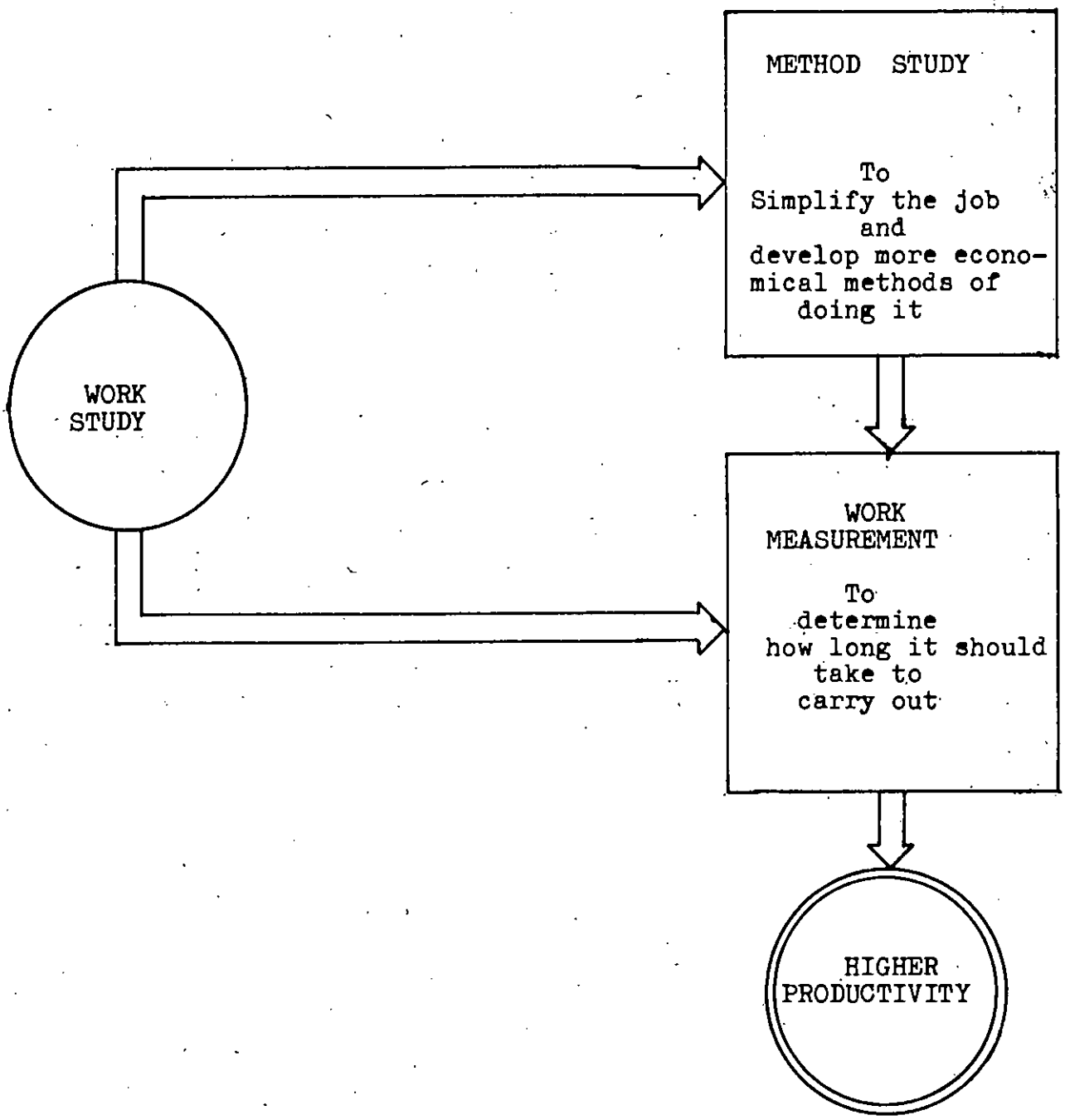
Work study was widely known for years as "time and motion study", but with the development of the technique and its application to a very wide range of activities it was felt by many people that the older title was both too narrow and insufficiently descriptive.

There are eight steps in performing a complete work study.

1. Select the job or process to be studied.
2. Record every things from direct observations.
3. Examine the recorded facts critically.
4. Develop the most economic method.
5. Measure the quantity of work involved in the method selected.
6. Define the new method and the related time.
7. Install the new method as agreed standard practice with the time allowed.
8. Maintain the new standard practice by proper control procedures.

Steps 1, 2 and 3 occur in every study, where the technique being used is method study or work measurement. Step 4 is a part of method study practice, while step 5 calls for the use of work measurement.

Work study consists of two complementary techniques - Method Study and Work Measurement. The relationship of method study and work measurement are shown in Figure-2.1.



Work study : a direct means of raising productivity.

Figure-2.1 : The relationship of method study to work measurement.

2.1.1 Human Factors Application in Work Study:

Good relations with the persons concerned must be established before work study is applied. Work study is not a substitute for good management and never can be. It is one of the "tools" in the manager's tool kit. By itself it will not make bad industrial relationship good, although, if wisely applied, it may often improve them. This has been the common experience of ILO management development and consultancy missions everywhere.

If work study is to contribute seriously to the improvement of productivity, relations between the management and the workers must be reasonably good before any attempt is made to introduce it, and the workers must have confidence in the sincerity of the management towards them; otherwise they will regard it as another trick to try to get more work out of them without any benefits for themselves (1).

2.2 METHOD STUDY

Method study is the systematic recording and critical examination of existing and proposed ways of doing work, as a means of developing and applying easier and more effective methods and reducing costs (5).

The objectives of applying method study in KCCL ware: (3)

- to improve process and procedures in Snow (tube), Snow (bottle), Powder section and Soap Processing Plant.
- to improve workplace layout in Snow, Powder and Soap production.
- to recommend better methods by reducing unnecessary fatigue and economy in human effort.
- to improve the use of materials, machines and manpower.
- to develop better physical environment.
- to ascertain as accurately as possible time allowances necessary for doing the job.

The manufacturing process of cosmetic and soap is a systematic, step by step process. Naturally the scope of implementation of developed and effective modifications are limited. In this study some modifications concerning manufacturing process and material handling have been suggested. These recommendations are expected to improve material/product handling, working condition and above all to improve productivity.

Details of these present and proposed modified layout and methods are given in Chapter-4.

2.3 WORK MEASUREMENT

Work Measurement is the application of techniques designed to establish the time for a qualified worker to carryout a specified job at a defined level of performance (5).

Work Measurement, as the name suggests, provides the management with means of measuring the time taken in the performance of an operation or series of operations in such a way that ineffective time is shown up and can be seperated from effective time. It can also be used to set standard time for carrying out the work. Work measurement is more likely to show up the management itself and the behaviour of the workers (1).

The purposes of work measurement are to reveal the nature and extent of ineffective time, from whatever cause, so that action can be taken to eliminate it; and then to set standards of performance of such a kind that they will be attainable only if all avoidable ineffective time is eliminated and the work is performed by the best available method and by personnel suitable in training and ability to their tasks.

The techniques of work measurement:

The following are the principal techniques by which work measurement is carried out: (2)

i) Work/Activity Sampling
ii) Stop-Watch Time Study
iii) Predetermined Time Standard (PTS)
iv) Standard Data.

The steps and the techniques which are necessary for the systematic carrying out of work measurement are shown diagramatically in figure-2.3

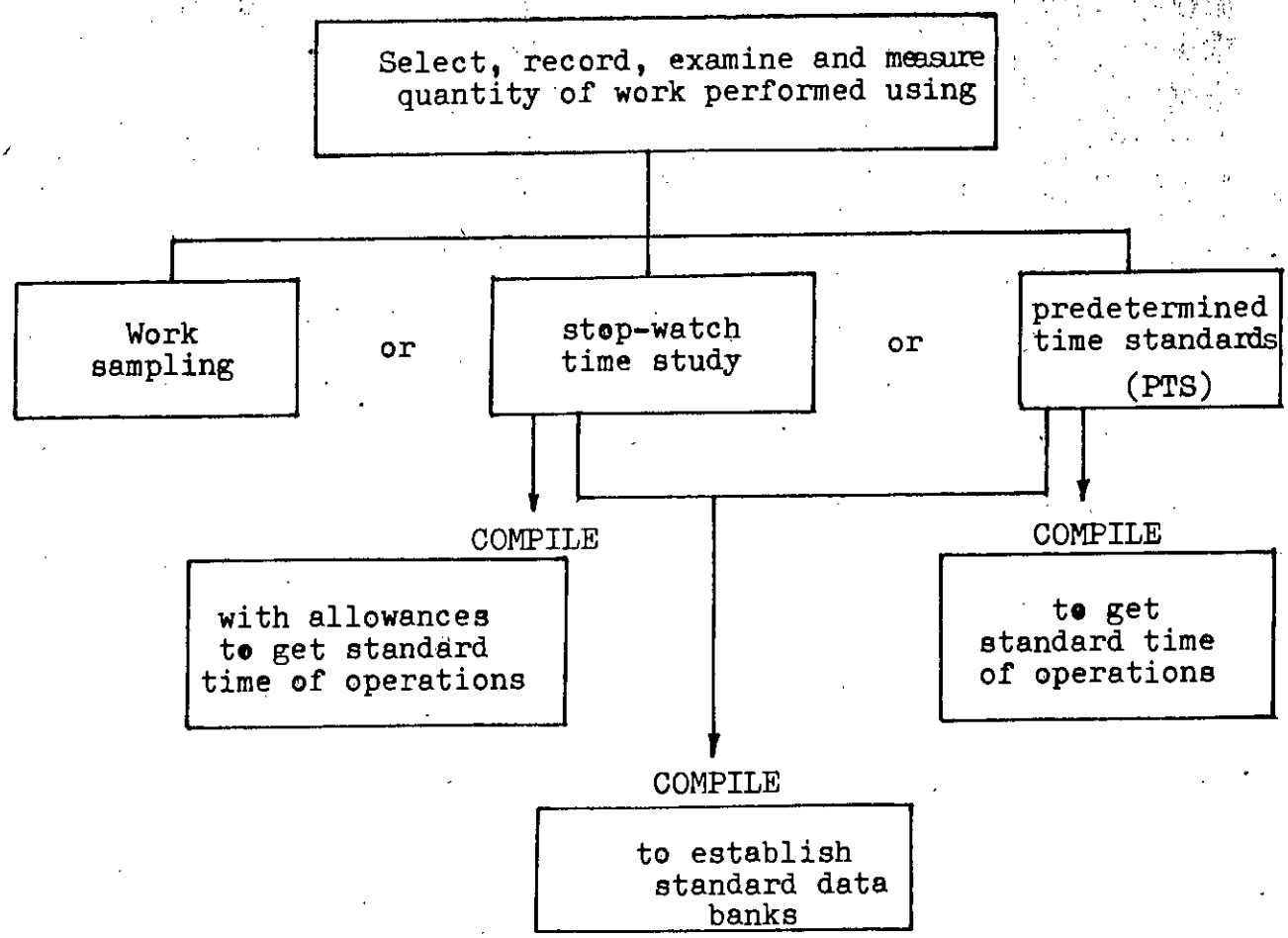


Figure-2.3 : The steps and the techniques necessary for the work measurement

2.3.1 Work Sampling:

Work sampling is a method of finding the percentage occurence of a certain activity by statistical sampling and random observation. It is also known as Activity Sampling Technique (5).

In order to obtain a complete and accurate picture of the productive time and idle time of the machines in a specific production area, it would be necessary to observe continuously all the machines in that area and to record when and why any of the machines were stopped. It would of course be quite impossible to do this unless a large number of workers spent the whole of their time on this task alone, an unrealistic proposition.

In this technique fixing the number of observation is a pre-condition for a perfect study. The more will be the number of observation more perfect will be the result of the study. The following universal formula is used to calculate the minimum number of observations (7).

$$N = \frac{4P\,(100 - P)}{L^2} \qquad \ldots \qquad [1]$$

Valid for 95% Confidence Limit.

where, N = number of observation

P = occurance of an event (%)

L = accuracy limit.

For this study L = $\pm$ 7% is considered.

The calculation of minimum number of observation is shown in Appendix-L.

When the sample size is large enough and the observations made are indeed at random, there is a quite high probability that these observations will reflect the real situation, plus or minus a certain margin of error.

One can have the complete accuracy achieved by continuous observation and, at the other end, every doubtful result is derived from a few observations only. The size of the sample is therefore important, and one can express his confidence in whether or not the sample is representative by using a certain confidence level.

2.3.2 Time Study

Time Study is a work measurement technique for recording the times and rates of working for the elements of a specified job carried out under specified conditions and for analysing the data so as to obtain the time necessary to carry out the job at a defined level of performace. The following steps were followed in making the Time Study: (2)

i) To obtain and record all the information available about the job, the operative and the surrounding conditions, which is likely to affect the work in Snow, Powder, and Soap production.

ii) To record the complete description of the method/process, breaking down the operation into various work stations.

iii) To examine the detailed break down to ensure that the most effective methods and motions are being used in the said process.

iv) To measure with a timing device (a stop watch) and recording the time taken by the operators to perform each work station of the Snow, Powder and Soap production processes in filling and packing parts.

v) At the same time, assessing the effective pace of the worker/operator relative to the observers concept of the rate corresponding to standard rating.

vi) To convert the observed times to 'Basic Times' by applying the mathematical formula.

vii) To determine the relaxation allowances by adding variable allowances, personal need allowances and basic fatigue allowances.

viii) To determine the Standard Time for the operation of filling, sealing and packing part of Snow, Powder and Soap production.

The essential Time Study equipments used were: (5)

- the stop watch
- the time study board
- the time study forms.

A form of general purpose study board with a stop watch arrangement is shown in Figure-2.3.2.

The top and continuation sheet of a general purpose time study form is shown in Appendix-R.

In addition, the following accessoreis are used in time study:

- calculator
- a reliable clock, with a seconds hand
- measuring instruments such as a tape measure, steel rule, micrometer, spring balance and tachometer.

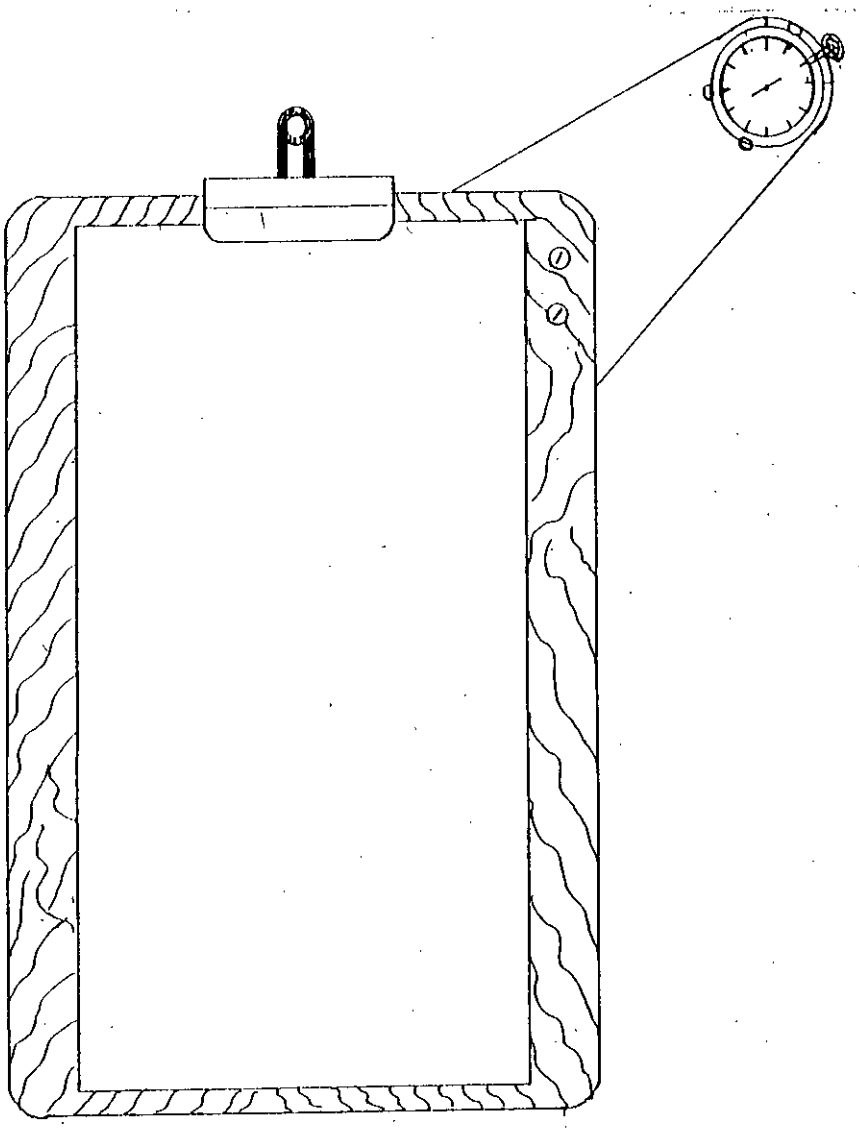


Figure.2.3.2 : General purpose Time Study Board with stop watch

2.3.3 Standard Rating:

Rating and allowances are the two most controversial aspects of time study. Rating is the assessment of the workers rate of working pace relative to the observer's concept of the rate corresponding to standard pace.

This standard level is the average rate at which qualified workers will naturally work at a job, when using the correct method and when motivated to apply themselves to their work. This rate of working corresponds to what is termed the standard rating, and is denoted by 100 on the rating scale recommended. If the standard pace is maintained and the appropriate relaxation is taken, a worker will achieve standard performance over the working hour (5).

Some of the factors affecting the working pace of the operator:

- Variations in the quality or other characteristics of the material used.
- Minor and unavoidable changes in methods or conditions of operation.
- Variations in the mental attention necessary for the performance.
- Changes in climatic and other surrounding conditions such as light, temperature, etc.
- Variations due to ability and training
- Variations due to attitude of mind, especially attitude to the organization.
- The pattern of his movements.

Table-2.3.3 : Examples of Various Rates of Working on the Principal Rating Scales.

Scales				Description	Comparable walking speed	
60-80	75-100	100-133	0-100 Standard		(mi/h)	(Km/h)
0	0	0	0	No activity		
40	50	67	50	Very slow; clumsy, fumbling movements; operative appears half asleep, with no interest in the job.	2	3.2
60	75	100	76	Steady, deliberate, unhurried performance, as of a worker not on piecework but under proper supervision; looks slow, but time is not being intentionally wasted while under observation.	3	4.8
80	100	133	100 (Standard Rating)	Brisk, business-like performance, as of an average qualified worker on piecework necessary standard of quality and accuracy achieved with confidence.	4	6.4
100	125	167	125	Very fast; operative exhibits a high degree of assurance, dexterity and coordination of movement, well above that of an average trained worker.	5	8.0
120	150	200	150	Exceptionally fast; requires intense effort and concentration, and is unlikely to be kept up for long periods; a "virtuoso" performance achieved only by a few outstanding workers.		

There are several scales of rating in use. The most common of which are designated by the 100-133, the 60-80, the 75-100 scales and the British Standard the 0 - 100 scale.

Table-2.3.3 shows examples of various rates of working on the scales mentioned.

2.3.4 Standard Time:

Standard time is the total time in which a job should be completed at standard performance.

The standard time for the job will be the sum of the standard times for all the elements of which it is made up, due regard being paid to the frequencies with which the elements recur, plus the contingency allowance (with its relaxation allowance increment). The contingencies and relaxation allowances are still percentages of the basic time. The standard time is expressed in standard minutes.

The work content of a job or operation is defined as: basic time + relaxation allowance + any allowance for additional work - e.g. that part of contingency allowance which represents work (5).

Basic time is the time for carrying out an element of work at standard rating. i.e.

$$\text{Basic Time} = \frac{\text{Observed Time} \times \text{Observed Rating}}{\text{Standard Rating}} \quad \ldots \quad [2]$$

Extension is the calculation of basic time from observed time.

Basic formula which is used in calculation of standard time is shown below:

$$\text{Standard time} = \frac{\text{Observed Time} \times \text{Observed Rating}}{\text{Standard Rating}} + \%\ \text{Relaxation allowances} \quad \ldots \quad [3]$$

The standard time for a simple manual job may be represented graphically as shown in figure.

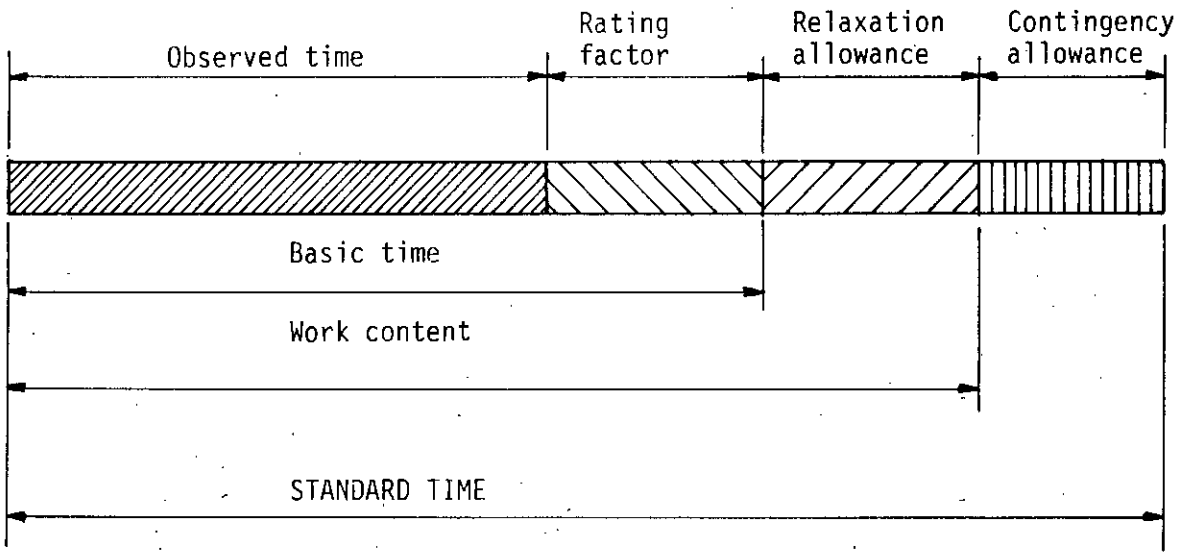


Figure-2.3.4 : The standard time for a simple manual job.

The basic work content is the irreducible minimum time theoretically required to produce one unit of output. This is obviously a perfect condition which never occurs in practice, although it may sometimes be approached, especially in processing industries.

The time taken by a man or a machine to carry out an operation or to produce a given quantity of product may be considered as made up in the following manner, which is presented in figure-2.3.5.

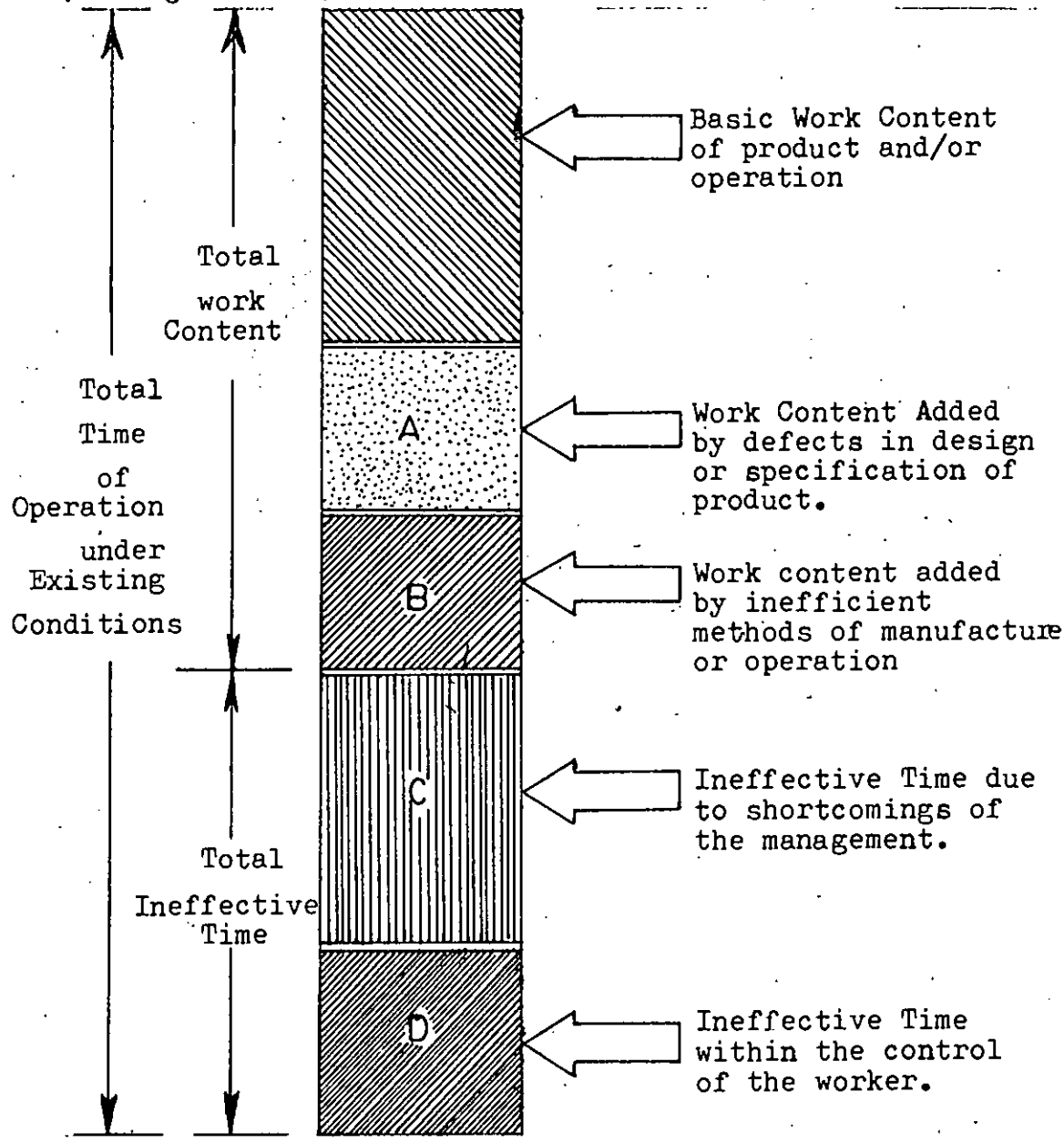


Figure-2.3.5 : Manufacturing time of a job.

If we decrease the above cycle, then the productivity of the processing industry will increase. We can decrease all element of the above cycle except basic work content of the job.

2.4 ERGONOMICS:

Over the centuries simple tools were developed to aid human activities. Such developments were the beginning of what we now call "Human Factor Engineering" or "Ergonomics". The task under consideration involves design of things and facilities so that they can reasonably serve human needs in a better way.

Many experts define ergonomics as the study of human's behaviour in relation to his work. It is the adaptation of work conditions to the Physical and Psychological nature of human and this results in most important principle of ergonomics. The central focus of ergonomics is the systematic application of relevant information about human abilities, characteristics, behaviour, and motivation in the execution of such functions. In simple terms, human factors has been referred to as designing for human use (2).

The objectives of ergonomics or human factor engineering are as follows:

i) to enhance the effectiveness and efficiency with which work and other human activities are carried out.

ii) to maintain or enhance certain desirable human values like health, safety, sanitation, etc.

The central approach to ergonomics relates to the consideration of human beings in carrying out such functions as follows:

i) fitting the demand of work to the efficiency of human in order to reduce stress;

ii) designing machines, equipment, and installations so that they can be operated with great efficiency, accuracy and safety;

iii) working out proportions and conditions of the work place to ensure correct body posture;

iv) adapting lighting, air-conditioning, noise, etc. to suit humans physical requirements.

In this study efforts were made to maximise machine utilization with minimum human intervention. Human comfort and satisfaction were considered in KCCL. On the basis of study some modifications, recommendations were made and are presented in Chapter-5.

Chapter – III

METHODOLOGY

3.1 INTRODUCTION

Before fixing the subject of investigation/study, the whole existing cosmetic and soap manufacturing processes in KCCL was carefully observed. Since the study was confined only in cosmetic and soap manufacturing sections and the manufacturing processes are arranged in a respective manner, the following methods were adopted considering the disadvantages of conventional method:

a)	To simplify the job and develop more economical methods.	:	Method Study Procedure.
b)	To determine how long it will take to carry out the jobs.	:	Work Measurement Technique.
c)	Percentage of working time	:	Work Sampling Technique.
d)	To determine time allowances.	:	Method defined by ILO (value, table and charts (5).
e)	To determine working ability and manpower requirement.	:	Time Study (stop watch method) and Activity Sampling Technique.
f)	To determine manpower requirement for different work stations.	:	Production line balancing method. (man-power balance)
g)	To determine standard time and expected output (Production Study).	:	Time Study ((stop watch method).
h)	The systematic applications of relevant information about workers abilities,	:	Ergonomic Methodology.

	characteristics, behaviour, and motivation while executing such functions.		
i)	To suggest improved production: method, sitting arrangement of worker, equipment layout, equipment colour, working atmosphere, etc.		Ergonomic Methodology.
j)	To suggest improved material handling procedure.	:	Ergonomic Methodology.
k)	Further Research on the basis of Work Study and Ergonomics.	:	Human Factors Engineering.

3.2 DATA COLLECTION ACTIVITIES

The data collection activities started in June, 1991. All equipments required for time study were arranged before starting the study.

KCCL is an old factory. Production method and process technology which are used in KCCL are also old. Moreover, the workers are not well qualified and trained. Naturally, the workers were first taught about the work study techniques, the functions and objectives of ergonomics. Being fully aware of work study techniques, the workers finally co-operated to participate in the study.

A problem arised when the workers union (CBA) of KCCL interupted in the study. It could be mentioned here that the CBA of KCCL is very strong organization. As the CBA never heard of such study, they tried to stop the study

immediately. After giving assurance to the CBA that the purpose of data collection is only for study purpose and it will not creat any adverse effect on them from the management side, they started cooperating. Besides, discussions about the benefits of the study and the procedures of the study were held with the management of KCCL several times.

The first step of data collection activity was to observe the soap and cosmetic processes. All data and informations available about the manufacturing processes and also relevant to the processes were recorded. After examining these data and informations, the soap and cosmetic plants were divided into three sections in order to carryout the study and then divided each section into several elements of work (Work Stations). Thus the process flow chart which are shown in Appendix-S was prepared.

The existing manufacturing processes of cosmetic and soap plants were carefully observed and ineffective methods/parts were eliminated from the processes before carrying out the work measurement study (Work Sampling and Time Study). After conducting method study, some improved and modified methods for every sections were suggested.

For work activity sampling, data were taken in three groups on different days, one group for each section.In this regard some personnels of KCCL helped in the study. Workers were

divided into three categories during taking activity sampling data: (i) Present in the job and Working (W), (ii) Present but not Working i.e. Idle (NW) and (iii) Not present at work station i.e. Absent (A).

The observed time for workers recorded by stop watch time study was recorded in general purpose time study Top and continuation sheet which are shown in Appendix-R. For time study, average observed time was taken for calculation. The working pace rating of each worker was done in accordance with the ILO standard, shown in Table-2.3.3. It tooks about six months time for completion of data collection activities.

Work environment, work place layout, manual material handling, various working equipment design (such as table, bench, chair, etc.) hand tools and devices were carefully studied in soap and cosmetic sections. The analysis was made from the Ergonomics point of view. Some modifications and suggestions on present production system and ergonomics applications are shown in Chapter-4 and 5.

3.3 CONDUCTING THE STUDY (Cosmetic Processing Plant)

For the purpose of the study the manufacturing product of cosmetic section was divided in three groups on the basis of process similarities, such as tube packing products, bottle packing products and powder groups. There are two production lines in each group.

Tube Packing Products

Products of these groups are tooth paste in tube, Snow in tube, Shaving Cream, etc. This process was divided into two parts. One is base mixing manufacturing part and the other is filling, sealing and packing part. In base part no data concerning activity sampling and observed time were collected. Only total time was recorded. Total time for base part is shown in Appendix-M.

Mixing material of base part is carried in filling and packing section manually and pumped to hopper for filling and sealing in tube. After that packing is done on packing table.

In filling and packing part the following observations were recorded:

i) Round wise filling machine capacity (Appendix-K)

ii) Activity sampling of filling machine operator (Appendix-F).

iii) This whole process was divided into several work stations.

iv) Observed time of various workers were recorded at every station (Appendix-J).

v) Activity sampling data was also recorded at every work station (Appendix-E).

vi) Relaxation allowances were calculated (Appendix-B).

vii) Leave and absenteeism rate was calculated (Appendices-O and P).

viii) Calculated manpower requirement on the basis of time study through production line balancing (Appendix-G).

Bottle packing products

Example of these products are snow in bottle and cream (Pomade) in bottle. Base part of these group is same as above mention group. Only filling, sealing and packing part is different. Here filling is done in a bottle and bottle cap fitting is done on a seperate machine. In this group the above mentioned studies were conducted which are shown in appendices.

Powder groups

This group differs from the groups mentioned above. In base part raw materials are crushed and mixed and then sieved and transferred manually to filling and packing section in drums. Filling in a container is done by the filling machine. Powder is fed to filling machine by vacuum pump (22 inch of Hg). Each production line has two filling machines. One is single and other is double contniner filling. Container sealing is done manually by hammering. After this operation all containers are cleaned by towel and then final packing is done in six dozen cartoons. Here also the same studies were conducted as above.

Leave and Absenteeism statement for previous year was collected from the KCCL authority to determine the percentage of Leave and Absentceism which was found to be 16.99% (Appdneix-O).

Process flow chart for Cosmetic and Soap manufacturing process are prepared which is shown in Appendix-S.

3.3 CONDUCTING THE STUDY (Soap Processing Plant)

There are four production lines in soap processing plant. During the study three production lines were in running in three shifts. P_1/P_2 line was engaged in producing Blue Bar while P_3 lines were producing Lemon Dew and 570 soap respectively. Generally pay/wages roll workers work in A and B shifts, C shift is fully run during overtime hours.

Stamping and packaging machines are not required in manufacturing Blue Bar soap. During extrusion process stamping the soap is done by a dye at the same time and is marketed in paper cartoon (72 pcs. in one cartoon) or in wooden patty box (180 pcs in one petty). No additional wrapper is used on the soap. The same procedure is also followed for marketing 570 washing soap. But in case of 570 washing soap, trade mark is stamped on the soap by stamping machine. During manufacturing of this soap (570) two soaps are extruded together through extrusion process.

Lemon Dew (toilet soap) is wrapped with additional paper by wrapping machine. This soap is marketed in paper cartoon contain 72 pcs. in each cartoon.

According to the manpower list of KCCL, different number of

workers are engaged in different work stations of a production line. But in practice the workers do not work according to the prescribed manner. Obviously, for the sake of simplicity of observations, work descriptions and terminology were used as per existing condition during activity sampling. For example packaging work is divided into filling, caping and packing group and separate manpower is allocated to each group of packaging work. But in practice the workers accomplish the full task in one work station. Therefore, the whole process was considered as packaging work and was noted in activity sampling sheets.

In wastes removal and cleaning, separate manpower has been allocated for each plant by KCCL Authority. But in practice a single group is engaged in the job serving all plants. The work was considered as a common job of the whole plant. Similarly different types of service works such as - storing, laboratory, etc. were also considered as Utility Service.

Data for activity sampling were collected which are shown in Appendices - E and F. Data of Time Study were analysed and are presented in concise form in Appendices- G, H, I, and J.

The main objective of analysing activity sampling data was to calculate manpower requirement. It has been mentioned already that activity sampling was conducted in three plants and for Utility Plant separately. All the required data are

shown in Appendix-E. After observation, percentage of activity of every work station and group was calculated separately. These percentages are also shown in data table of Appendix-E.

Basic formulae which were used in calculation are shown below:

i)	No. of workers/operators required to perform work content	=	(No. of workers allocated x % of working) ÷ 100
ii)	No. of workers required considering relaxation allowance	=	(No. of workers/operators required to perform work content) x (1 + % relaxation allowances)
iii)	No. of workers required considering leave and absenteeism	=	(No. of workers required considering relaxation allowances) x (1 + % of leave and absenteeism)
iv)	Recommended No. of workers per shift	=	(No. of workers required considering leave and absenteeism rounded to next higher figure).

Leave and Absenteeism statement for previous year was collected from the KCCL to determine the percentage of Leave and Absenteeism which was found to be 19.83% (Appendices - O and P).

Details of manpower determination of P_1/P_2, P_3, P_4 and Utility Services are presented in Appendices - C, D and A. While determining the recommended manpower all decimals were converted into next upper full number. So if this number of required manpower is implemented, the worker will enjoy more relaxation than allowable relaxation allowances.

In each plant one supervisor is allowed to supervise the plant. To supervise the workers and employees of washing soap and toilet soap section, foremans are allocated separately. A concise list of calculated required manpower for each plant is presented in Appendix-A. Allowable manpower per plant or per shift is also presented. In a definite time total required manpower could be determined from the plant while it is running.

It is seen from the analysis that the results of recommended manpower fully satisfies the present production demand.

3.4 DETERMINATION OF TIME ALLOWANCE:

It is very difficult to determine precisely the allowances needed for a given job. Working procedures of different work places of cosmetic and soap section in KCCL were carefully observed. Specially, emphasis was given on working conditions, such as sound, temperature, humidity, light, ventilation, dust, fume, noise, colour, physical weight, cleanliness, vibration, air conditioning, etc.

The basic model for the calculation of allowances is shown in figure-3.4. It will be seen from this model that relaxation allowance is the only time added to the basic time. Other allowances, such as contingency, policy and special allowances are applied under certain conditions only.

Relaxation allowance is an addition to the basic time intended to provide the worker with the opportunity to recover from the physiological and psychological effects of carrying out specified work under specified conditions and to allow attention to personal needs. The amount of allowance will depend on the nature of the job (5).

On the basis of these informations points were counted from charts and tables constituted by International Labour Organization (ILO). Examples of charts and tables used in calculating relaxation allowances are given in Appendix-N.

Percentage of variable allowances at every work station in the process were calculated on the basis of highest point of all factors affecting the task.

The allowance for personal needs was taken to be 10% considering the environmental condition of the factory. Though ILO suggests 5% - 7% time allowances for personal needs.

Every work creates fatigue. The allowance was considered to be 5%, though ILO suggests 4% fatigue allowances. Relaxation allowances is determined by adding variable allowance, personal needs allowance and basic fatigue allowance.

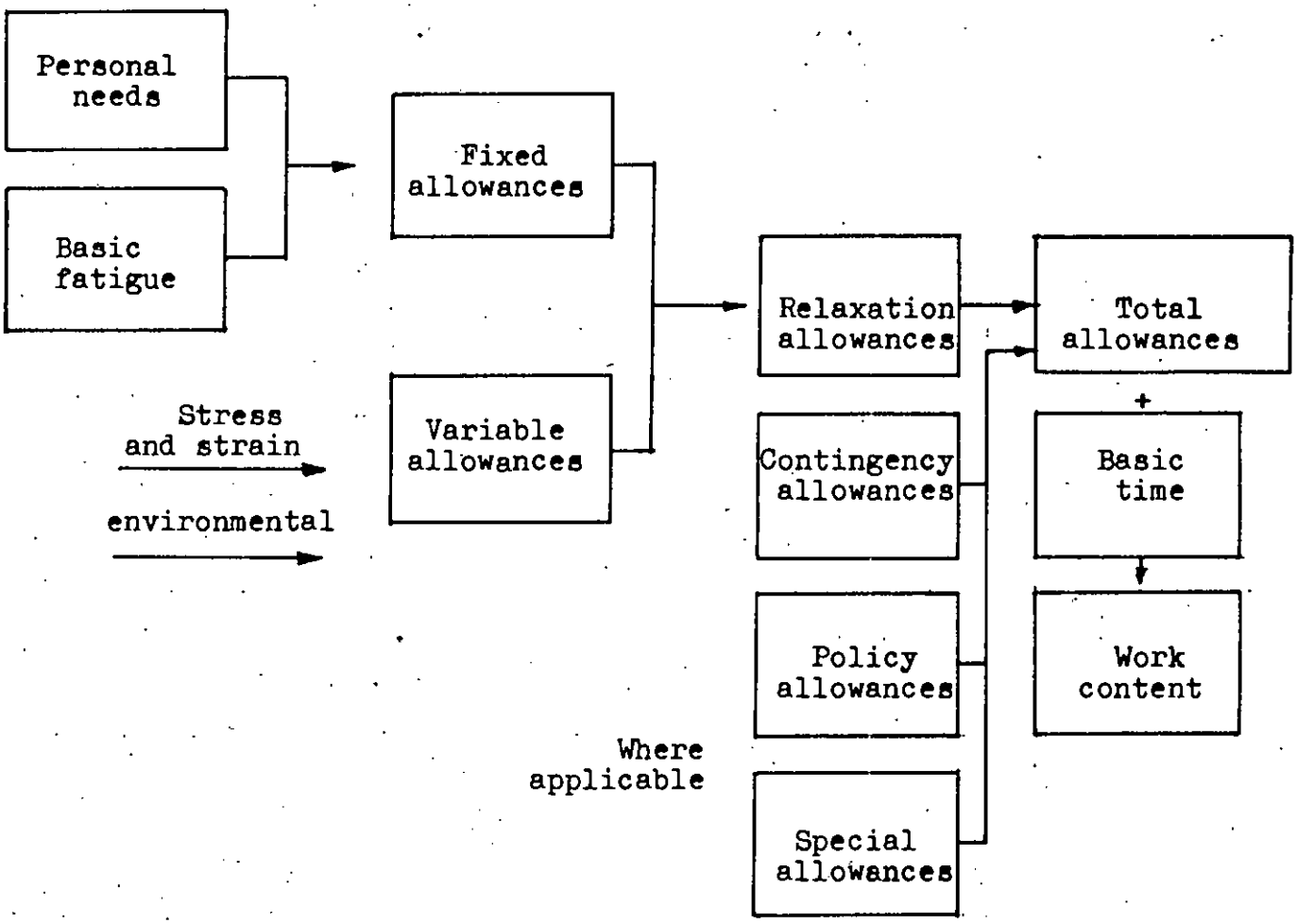


Figure-3.4 : The basic model for the calculation of allowances

Relaxation allowances of different working stations in the cosmetic and soap processing plants are presented in Appdneix-B.

Chapter — IV

SUGGESTED IMPROVED/MODIFIED PRODUCTION METHODS

Some suggested improved/modified methods with sketches are presented in this chapter for the following process plants considering method study and Ergonomic analysis.

	Name of the Plant		Improved/Modified Methods Proposal
4.1	Snow (in tube)	i)	to modify in conveyor system.
		ii)	to provide a vertical discharge hopper.
4.2	Snow (in bottle)	i)	to provide a scraper and conveyor system.
		ii)	to modify manual capping machine to continuous capping machine.
		iii)	to provide an Automatic Levelling Machine.
4.3	Powder Plant	i)	to provide a conveyor system.
		ii)	to provide Dust Collector.
		iii)	to provide an Automatic Rotex Cap Fixing Machine.
4.4	P_1/P_2 (Blue Bar Soap)	i)	to modify packing layout and method.
		ii)	to modify extrusion procedure.
4.5	P_3(Toilet Soap)	i)	to modify Packing Table and Layout.
4.6	P_4 (570 Washing Soap)	i)	to modify Packing Table and Layout.

4.1 PACKING IN PLANT SNOW (IN TUBE)

i) Proposed Modification in Conveyor System

The present method of packing is batch type. It must be modified to continuous and systematic process. Material flow should be stream lined by using conveyor. In the present process the materials are haphazardly handled by many workers on a table for packing. In the proposed process the conveyor is extended up to the final packing. The intermediate packing is conducted on the conveyor belt which will eliminate the above problems.

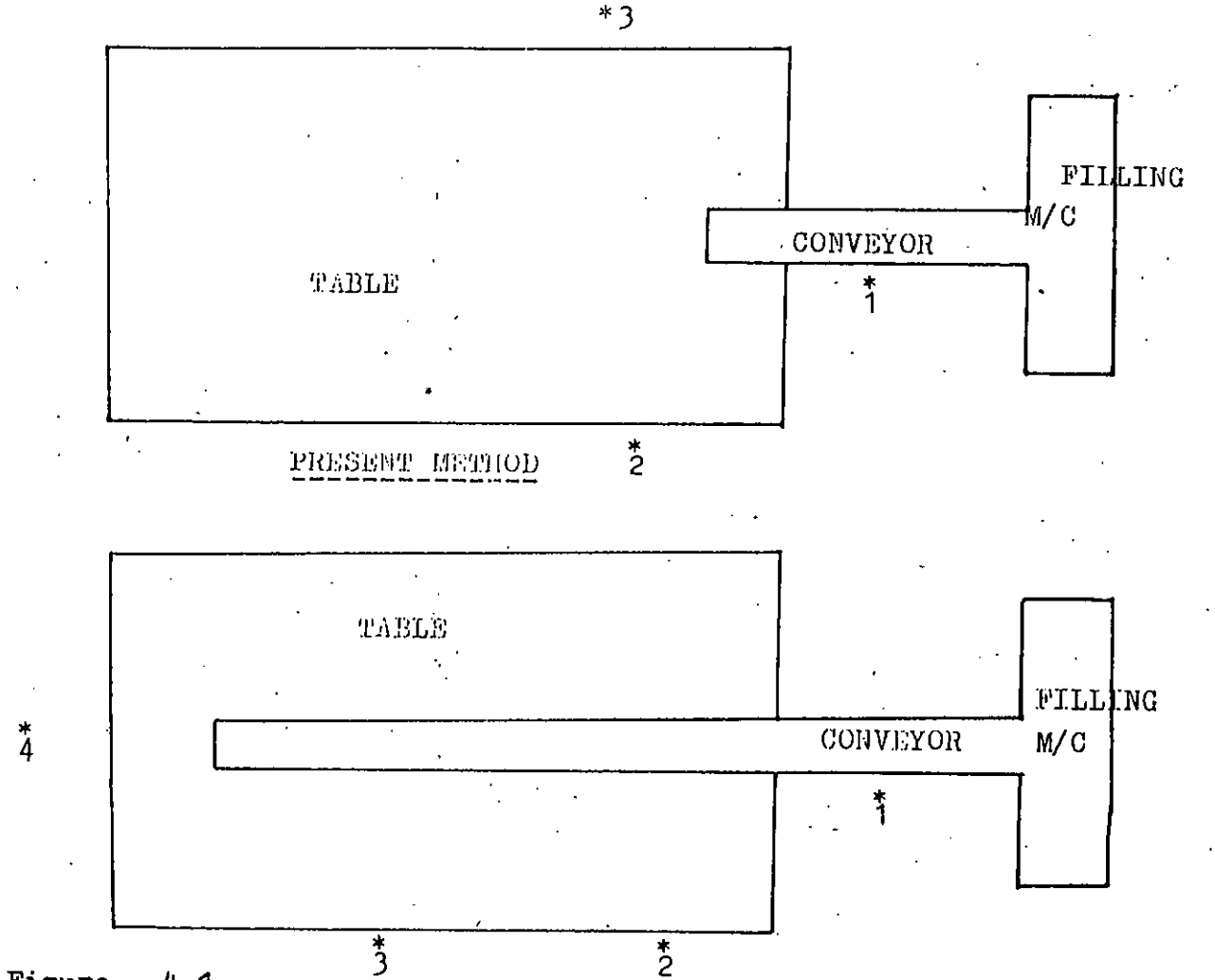


Figure - 4.1.

ii) **Providing a Vertical Discharge Hopper**

Present Method

Packing is done manually by the workers. Some workers are engaged in carrying packing materials from materials store to packing work station while others pack the tube in

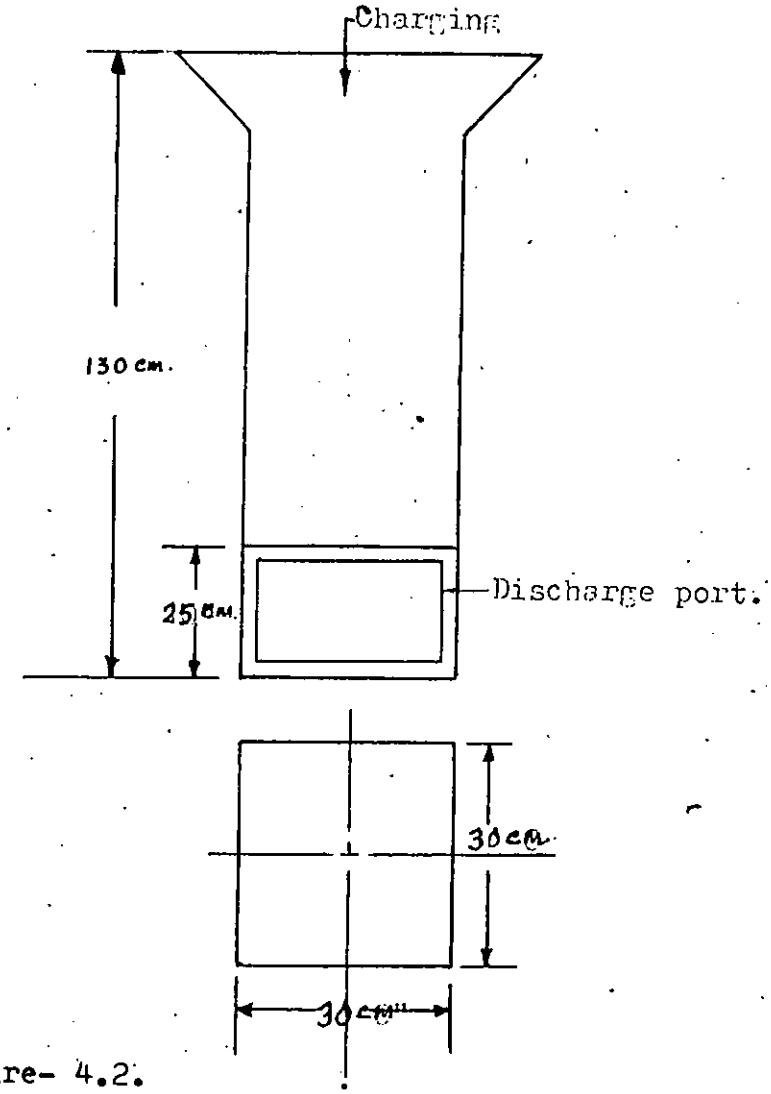


Figure- 4.2.

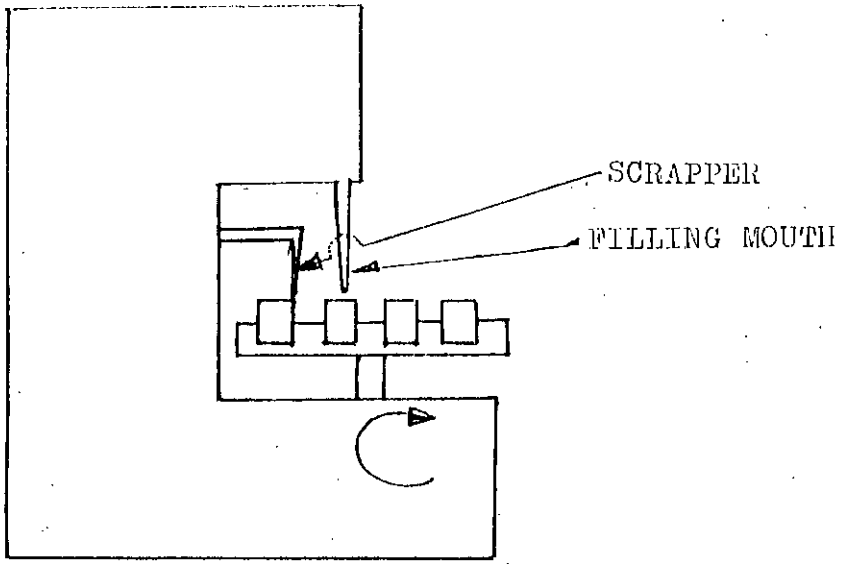
Number of workers engaged in packing could be decreased by using this method. A vertical discharge hopper is to be installed near the packing work station. Supply of packing materials i.e. feeding of packing boxes will be

automatically done if it is charged before starting the work. Subsequently those workers who are engaged in supplying packing boxes will be replaced by this discharging hopper. Details of the hopper is given above.

4.2 PACKING IN PLANT SNOW (IN BOTTLE)

i) Proposed Scraper and Conveyor System:

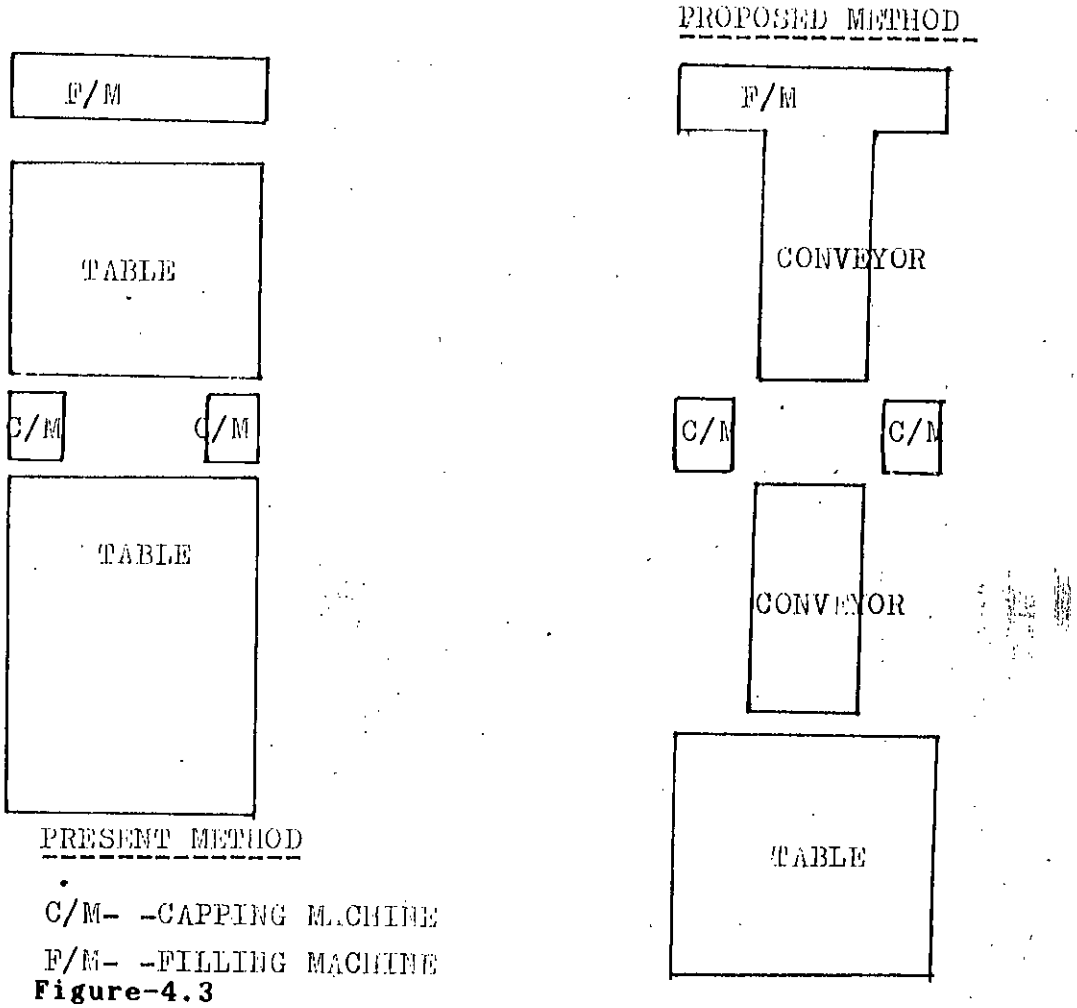
The present method of packing is batch type. Snow is filled by filling machine. The excess Snow which is left on the bottle above the bottle mouth level is scraped manually by hands. This operation can be done by providing a scraper in a suitable place on the machine.



PROPOSED METHOD WITH SCRAPPER

Figure - 4.3

A continuous and systematic process can be suggested to replace the present method. In the snow production line the material should be stream lined for easy and smooth process flow. To achieve this the material should be transfered from one operation to another by conveyor belt.



C/M- -CAPPING MACHINE

F/M- -FILLING MACHINE

Figure-4.3

ii) **Proposed Continuous Capping Machine**

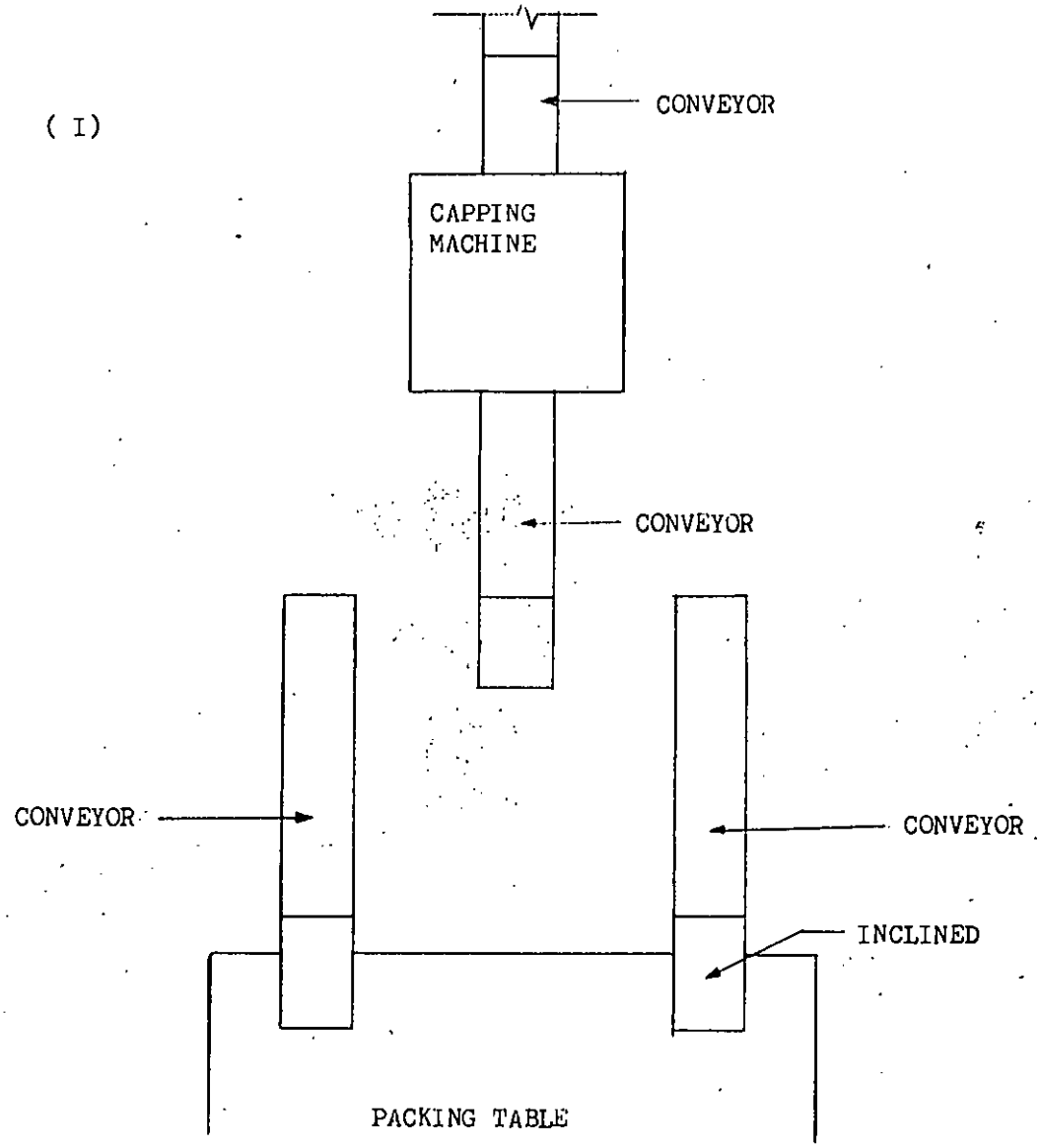
Present Method

In the present method the snow in bottles are taken to manual capping machine, where the workers do the work manually and after capping they put the bottles on the packing table.

Proposed Method

It is suggested to use continuous Automatic Capping Machine, which will increase the production rate. Also the use of a conveyor belt to shift the bottle into the packing table is suggested. The conveyor may be in two rows along the packing table depending upon the production rate, which is shown in Figure.

(I)


CONVEYOR
CAPPING MACHINE
CONVEYOR
CONVEYOR
CONVEYOR
INCLINED
PACKING TABLE

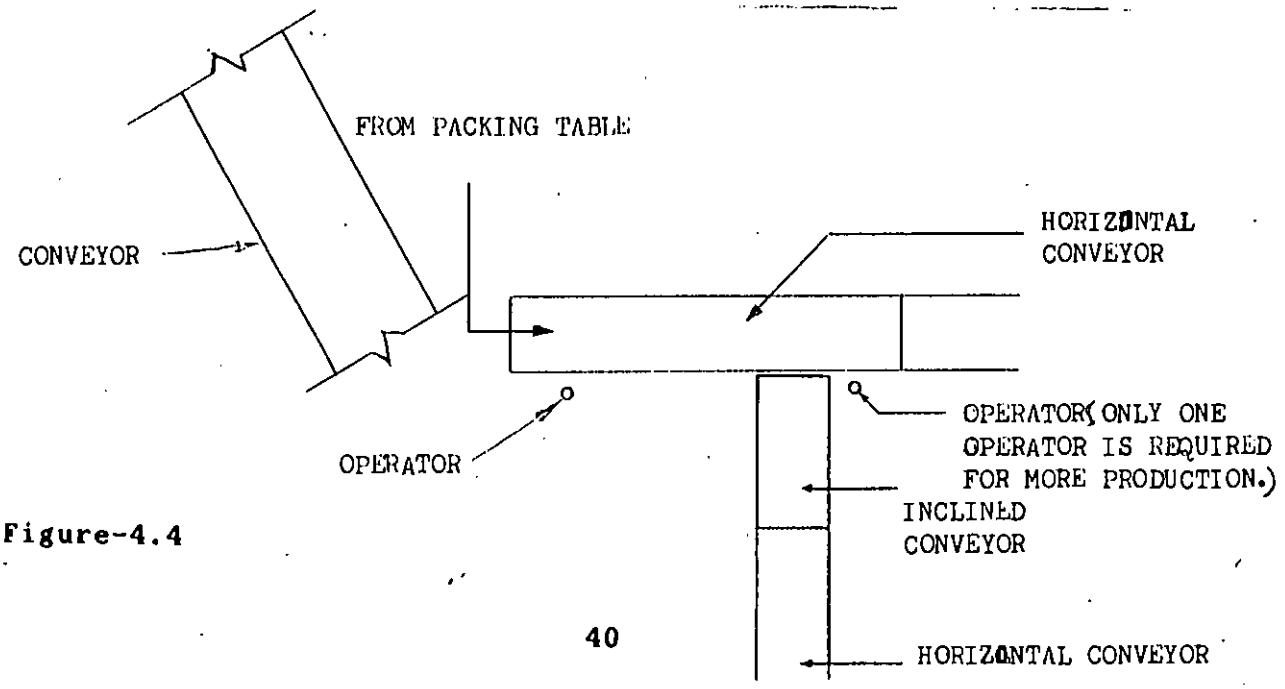

FROM PACKING TABLE
CONVEYOR
HORIZONTAL CONVEYOR
OPERATOR
OPERATOR(ONLY ONE OPERATOR IS REQUIRED FOR MORE PRODUCTION.)
INCLINED CONVEYOR
HORIZONTAL CONVEYOR

Figure-4.4

iii) Proposed Automatic Levelling Machine

Present Method

In existing method snow filling is done by manual filling machine and products are stocked manually on a table. Caping is done by capping machine through hand feeding and after capping products are placed on a table for next operation (levelling the bottle). On levelling table, the levelling is accomplished manually by four operators.

Proposed Method

Productivity could be increased by installing an Automatic Levelling Machine. Only one worker will be required for automatic levelling according to the proposed method.

4.3 PACKING IN POWDER PLANT

i) Proposed conveyor system

Filling and packing of powder are conducted in a batch, although the filling is a continuous process. The present process can be replaced by continuous process by introducing a conveyor belt, in place of long tables for batch preparations.

Each operation can be conducted on the conveyor, Additional hand press for cap fitting in place of hammering the cap can change the present process to a continuous process. The cleaning of containers can be done using air inplace of cleaning by towels.

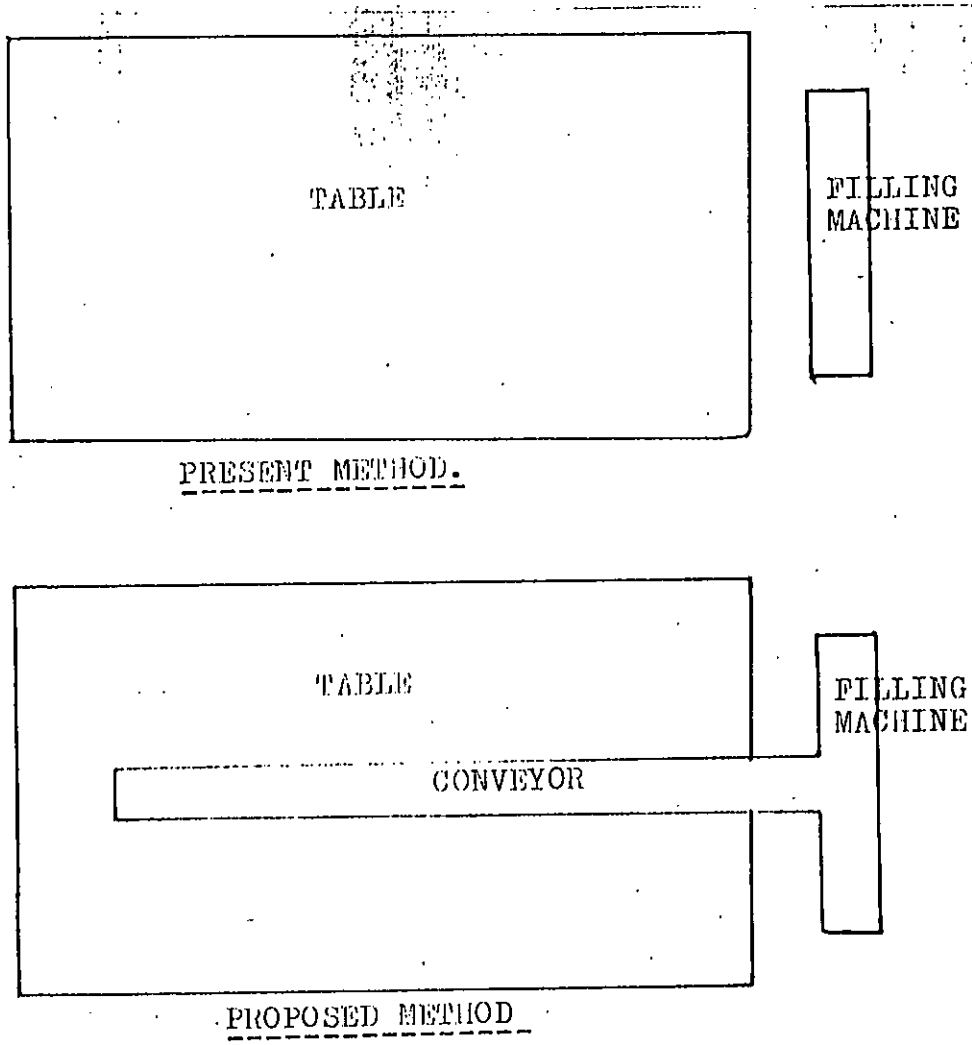


Figure-4.5

ii) Proposed Dust Collector

Present Method

All the raw materials of powder manufacturing are given in ball mills for better mixing and crushing to the proper grain size. After crushing and filtration processes, the mixture is collected into the drum for taking to the next operation. The powder mixture is fed into the hopper, from which the containers are filled.

The work place is contaminated by powder dusts. It happens because the powder grain size is very small and light. Due to powder dust every worker of the area become fatigue and sick very easily. The powder dusts contain chemicals which may deposit inside the lung walls. It is very harmful for the workers. It is very difficult for a worker to continuously work under such unhygienic condition. The workers loss their working efficiency. Also the workers who are working in this section for a long time frequently become sick and can not use their maximum working efficiency.

In the present system there is no provision for removal of such dust from the powder manufacturing area to make the working place hygenic.

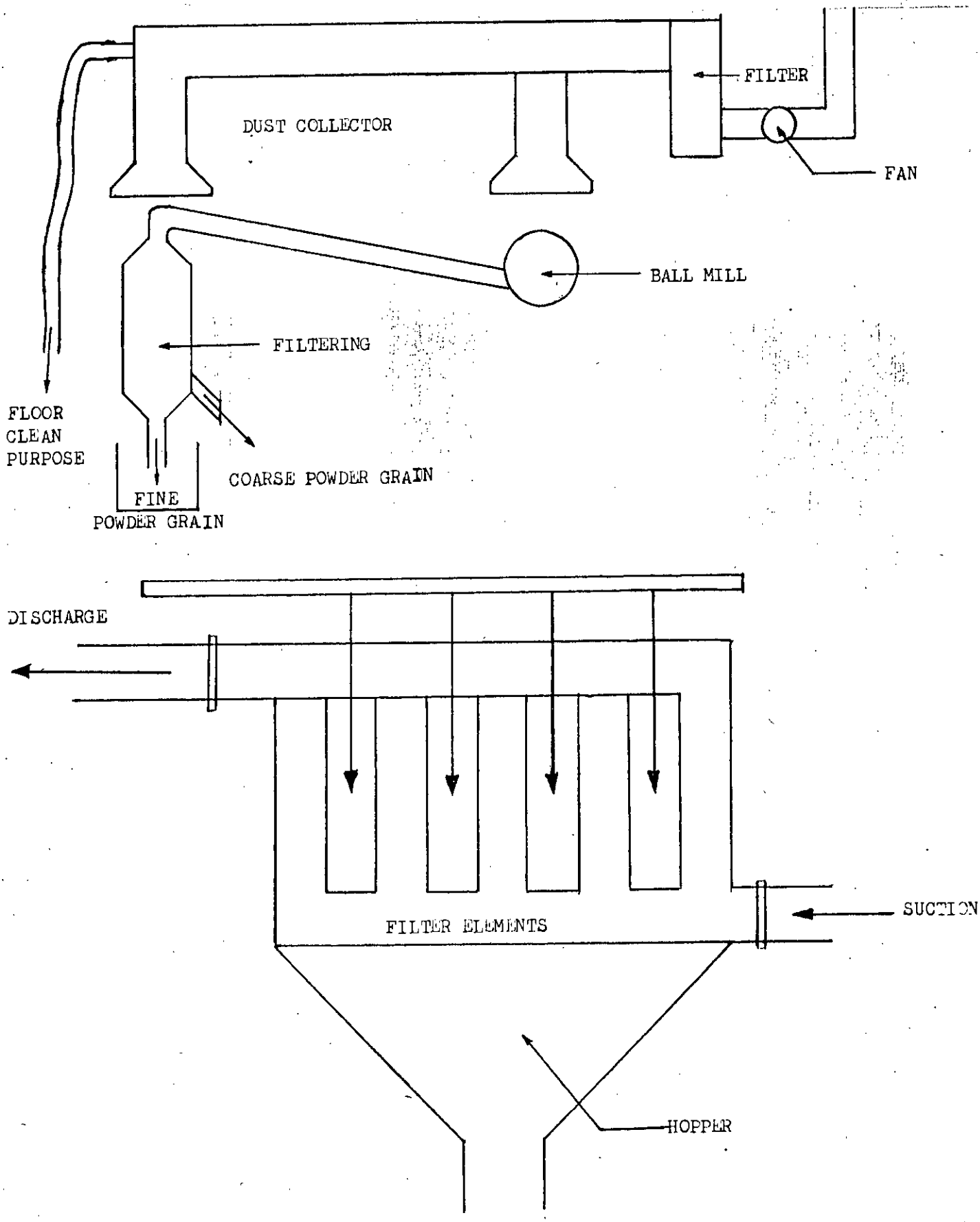

FILTER
DUST COLLECTOR
FAN
BALL MILL
FILTERING
FLOOR
CLEAN
PURPOSE
COARSE POWDER GRAIN
FINE
POWDER GRAIN
DISCHARGE
SUCTION
FILTER ELEMENTS
HOPPER

Figure- 4.6.

Proposed Method

For the improvement of such unhygienic condition the following suggestions have been made:

Use a dust collector as shown in drawings in every section (ball mill, filter section and final filling section). Also use suction device to collect all the dust from the floor and passes by exhaust fans.

By using the dust collector the dust fume will be reduce and fresh air circulation will ensure the working area more hygienic and comfortable. The worker can perform their work continuously and efficiently and can use their maximum of working capacity. It will also reduce fatigue.

iii) Proposed Automatic Rotex Cap Fixing Machine

Present Method

The present method of final cap sealing is done manually by using hammers. The system is: first the workers put caps on the containers, then they tighten it by impact hammering. By using the manual system the disadvantages are as follows:

1. Wastage of containers, caps and powder due to break of containers and caps.

2. Due to nonuniform impact the pressure over the cap is not uniform, which may keep loose contact and may result in deterioration of the quality of powder.

Proposed Method

For removing this problem, it is suggested to use an Automatic Rotex Cap Fixing Machine which will make the processes easy.

4.4 PACKING OF BLUE BAR SOAP (Plant P_1/P_2)

i) Modification of Packing Layout and Method

Present Layout and Method

Soaps from the Dryer are picked up by hands and placed in paper cartoons/boxes (72 pcs in each box). The boxes are kept on bench at a height of 63 cm from the floor. After filling, the boxes/cartoons are put on the floor and dragged to another place for taping. After taping the packed boxes are kept aside waiting to be picked up by trolley man.

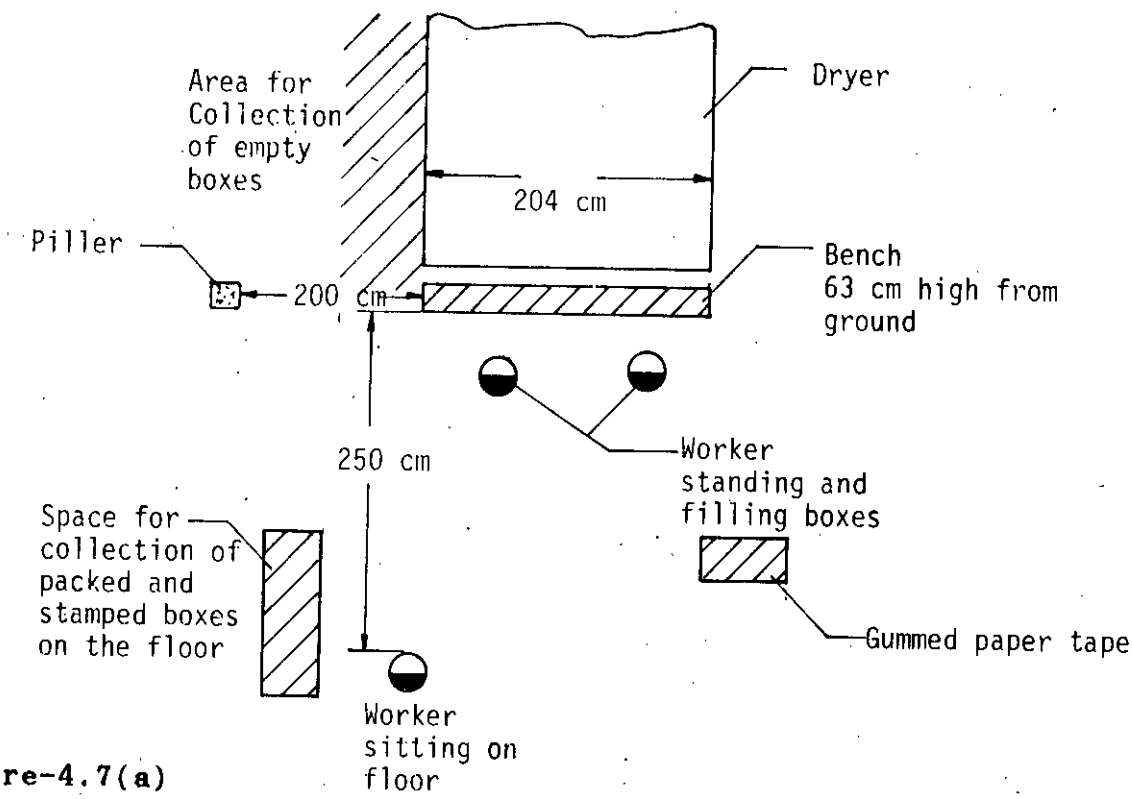


Figure-4.7(a)

Proposed Layout and Method

It is suggested to replace the bench with a roller table of the same height and 400 cm long. Workers will fill the boxes as usual placing the boxes on the roller table. After filling, the boxes will be pushed along the roller table to the extended part where a worker will tape it and will keep on the waiting trolley.

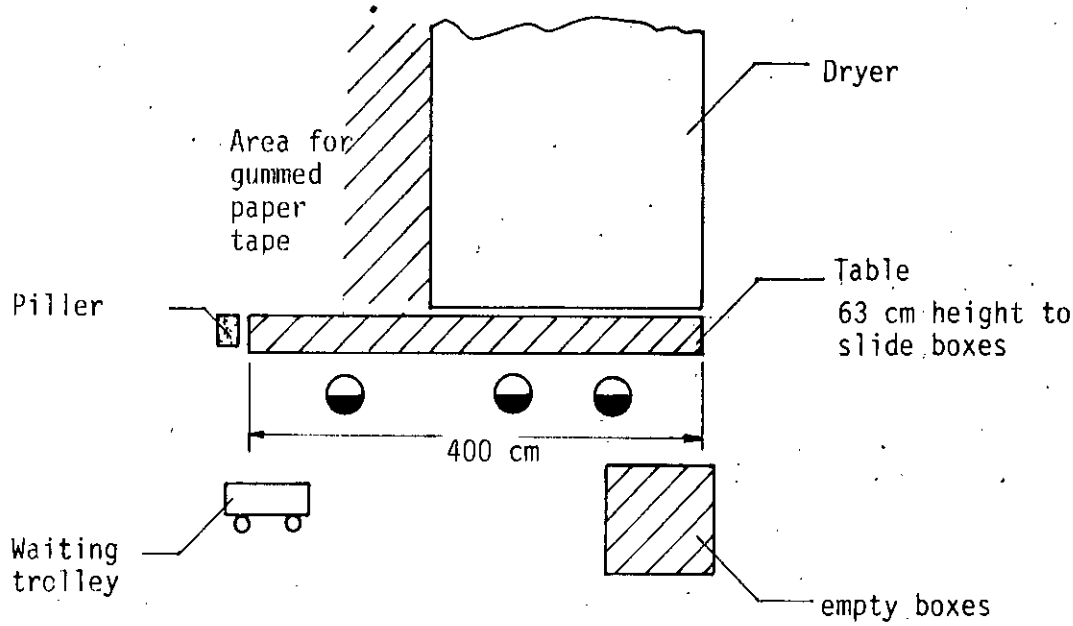


Figure-4.7(b)

ii) **Improved Method of Blue-Bar Extrusion Procedure**

Operating procedure of P_1/P_2 plant is just like P_4 line. Washing soap is produced in both plants. There is a system of extrusion of two bars with extrusion dye in automatic reducer. As a result production of 570 washing soap is much more than the production of Blue-Bar. To increase the production of Blue-Bar soap, two

bar extrusion method could be introduced by changing the dye.

In two bar extrusion method, printing could be done by setting two print dyes from both sides. Thin plastic roller or plastic plate could be placed between two bars to prevent contact between them due to pressure.

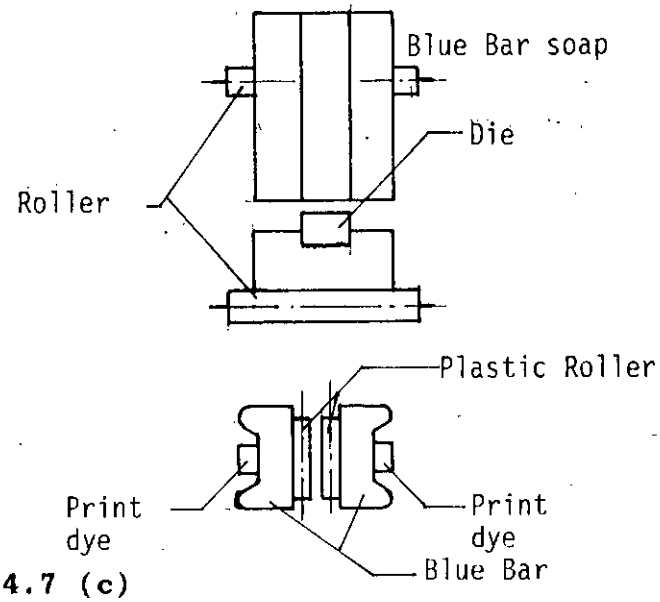


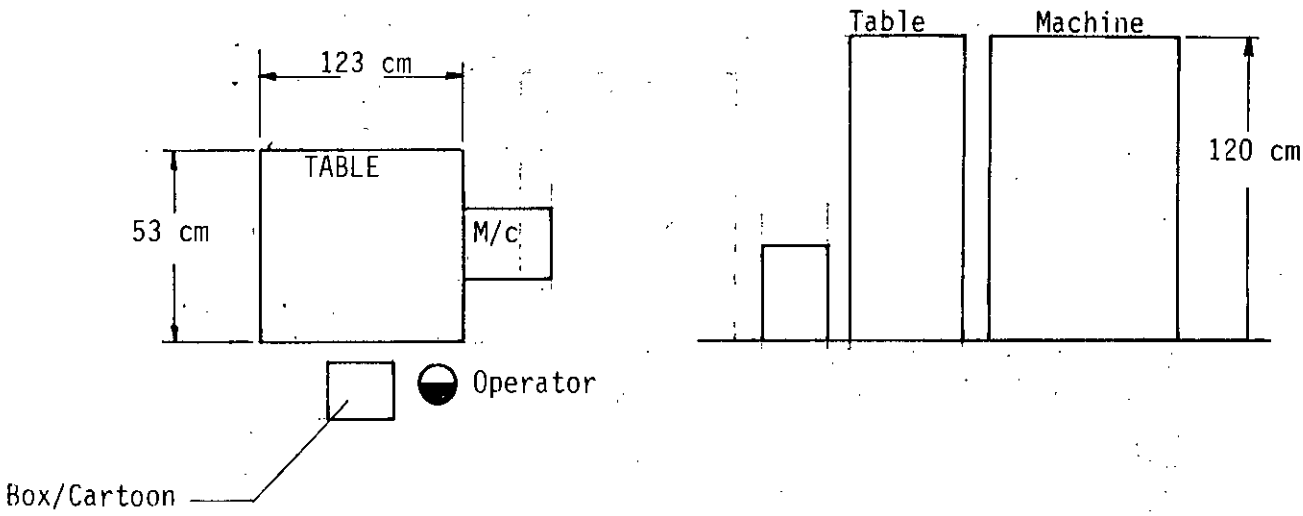
Figure-4.7 (c)

4.5 PACKING IN PLANT P_3 (TOILET SOAP)

i) Modification of Packing Table and Layout

Present Method

The height of the machine bed is 120 cm. and delivers soap at the same height on a 123 cm. x 58 cm. table. The workers sitting on one side of a table fills the cartoons which are kept by their sides resulting in awkward twisting motions of their bodies and limbs.



Proposed Method

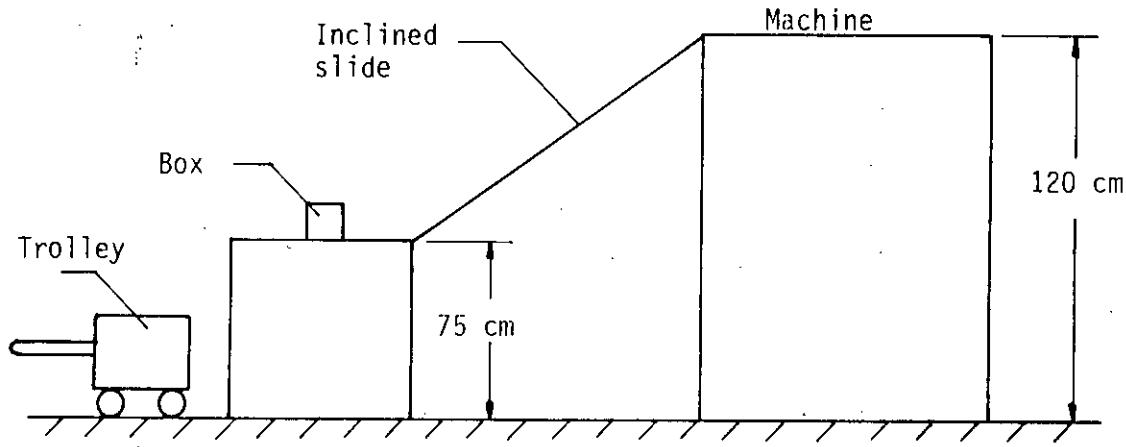


Figure-4.8

Existing table may be replaced by a narrow inclined slide, along which the soap will slide to a height of 75 cm. and reach a table at that height. The operator will pick up the cartoons and fill the cartoons on that table.

4.6 PACKING IN P_4 PRODUCTION LINE (570 Washing Soap)

i) Modification in Packing Table and Layout

Present Method

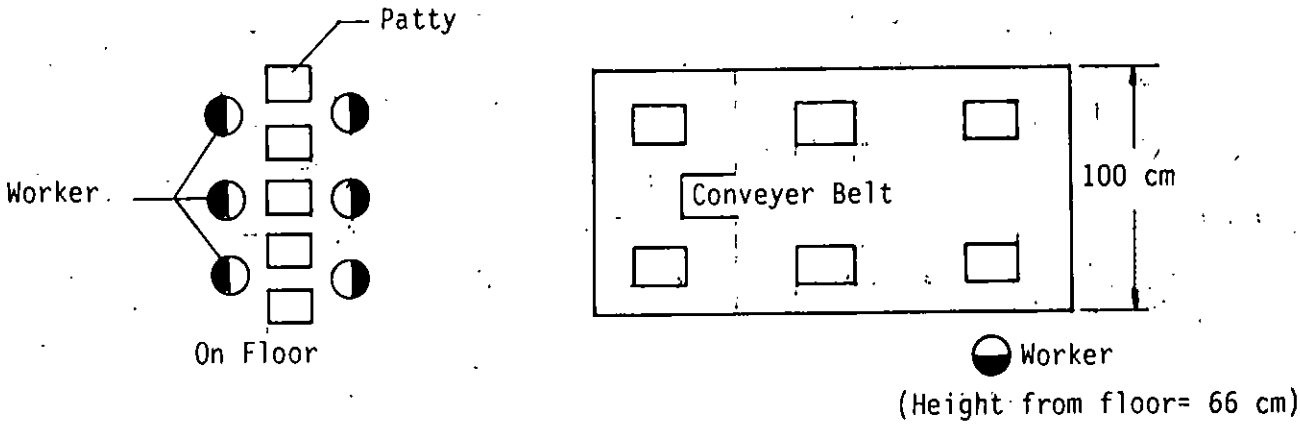


Figure-4.9(a)

At present the patty/cartoons are filled on a table which are then slided on the floors where it is nailed, wired and marked.

Proposed Method

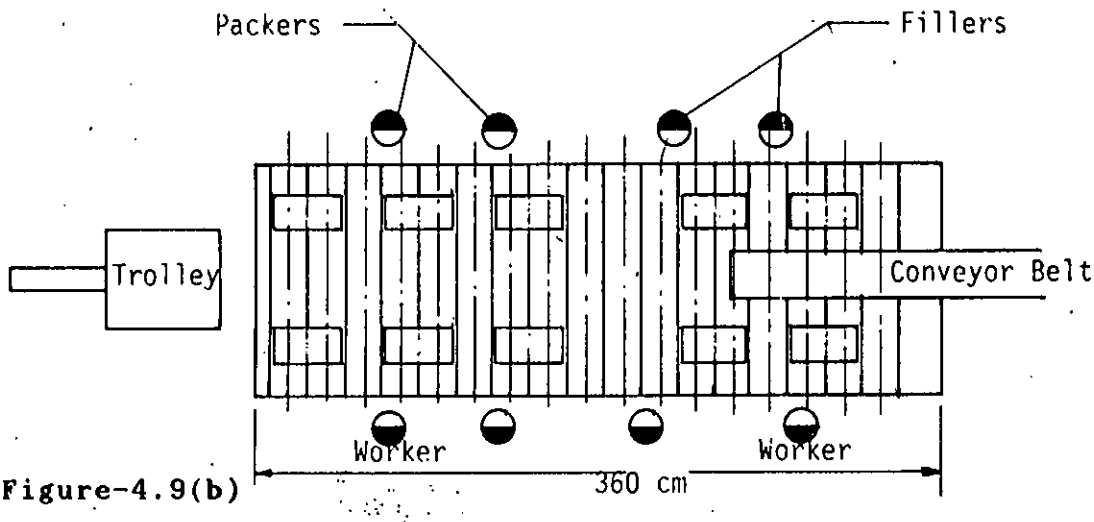


Figure-4.9(b)

The table may be extended up to 360 cm. Packaging workers may stand along the sides of the Fillers and may wrap, nail, wire and mark the patty/cartoon which may be kept on a waiting trolley.

Chapter – V

APPLICATIONS OF ERGONOMICS

5.1 INTRODUCTION

Ergonomics is the science of people at work. It involves the application of life science knowledge about human characteristics to benefit well-being and performance. Ergonomics measures go beyond the mere protection of the worker's physical integrity and aim at ensuring his well-being through the attainment of optimal working conditions.

Any where we care to look, we will find people trying to adjust to difficult situations. Sometimes the difficulties are minor, sometimes serious. In many instances, the reason for the difficulty is that too little thought has been given to matching the task to human capacities. Tables are too high, boxes are too heavy, doors are too narrow, instructions are confusing, shelves are too high, hand tools are awkward, etc. Sometimes with only slight frustration, discomfort or loss of speed or accuracy people adapt to these situations. Adaptability is a great human asset. However, there is always some cost.

In the industrial context this cost can accumulate rapidly to assume significant proportions. Postural discomfort can

lead to distraction and absenteeism in the short term and chromic health problems in the longer term. Small errors accumulate and can affect performance. All too often trivial effects combine to creat accidents. Ergonomics tries to minimize these problems (9).

In view of the above an ergonomical study was conducted in different sections of KCCL and some modifications/ improvements were suggested to improve the present working condition. The purpose of these suggestions was to help developing comfortable conditions for the workers. These will reduce the physical work-load, improve working postures and reduce the effort of certain movements to make handling load easier and smooth.

5.2 THE DESIGN OF WORK PLACES

5.2.1 Working Heights:

In KCCL most of packing, filling, wrapping, folding, cleaning, levelling and tapping jobs are done on tables in different work stations. The workers stand by the side of the tables and perform their jobs. The height of the working tables of soap and cosmetic sections are as follows:

Table 5.2.1 : Existing working heights of tables while standing

Sl.No.	Section	Table Height (CM)
1	Snow (in tube) Tooth Paste	66
2	Snow (in bottle) Packing (one dozen) Levelling bottle	66
3	Powder	78
4	P_1/P_2 Plant (Blue Bar soap production)	63
5	P_3 Plant (Toilet soap production) Belt height	120
6	P_4 Plant 570 Washing soap production	70

Ergonomically, the most favourable working height for handwork while standing is 5 - 10 cm below elbow level. Unfortunately, the present working height of these tables are not compatible.

The problems that are faced by the workers while working on these tables are:

i) Excessive stress is developed in legs

ii) Back pain due to inclination of spinal cord

iii) Muscular fatigue, etc.

These factors reduce worker's working capability. To boost up production and to make the job easy and smooth, all working table height of KCCL should be modified depending on the nature of the job as per Figure No.5.2.1 (a) (4).

Ergonomically it is often desirable to be able to adjust the working height to suit the individual as per Figure 5.2.1 (b) (4).

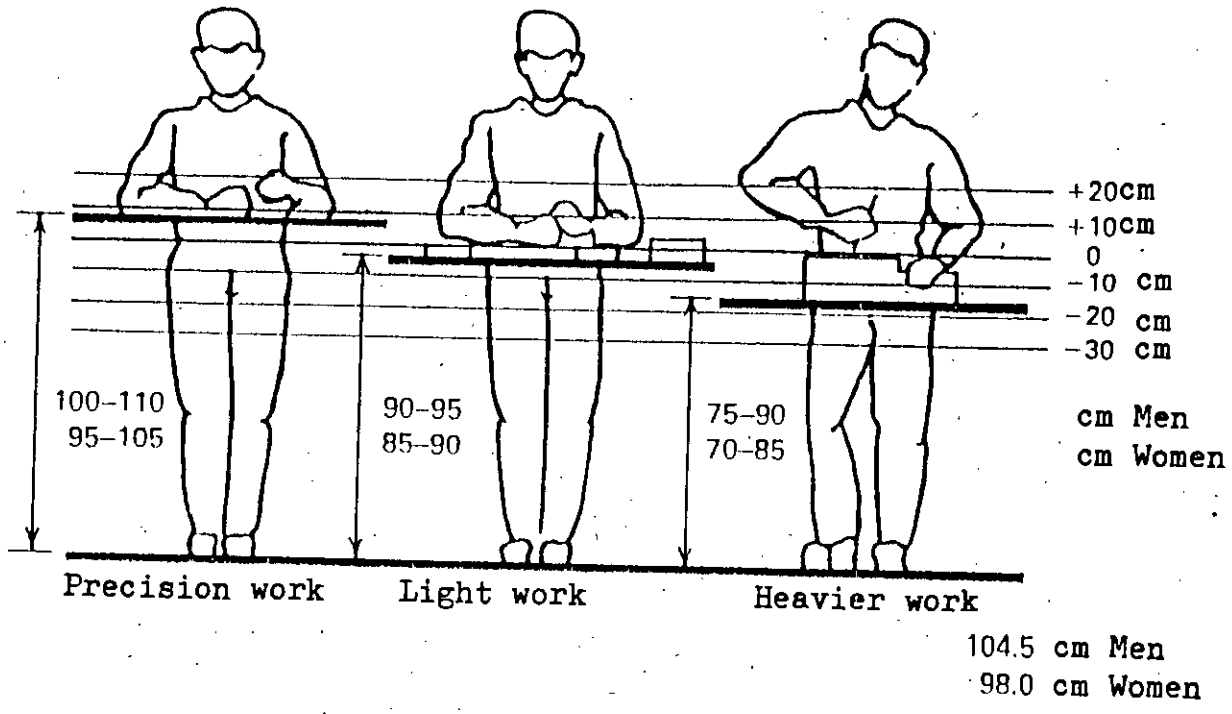


Figure-5.2.1 (a) : Recommended heights of bench for standing work

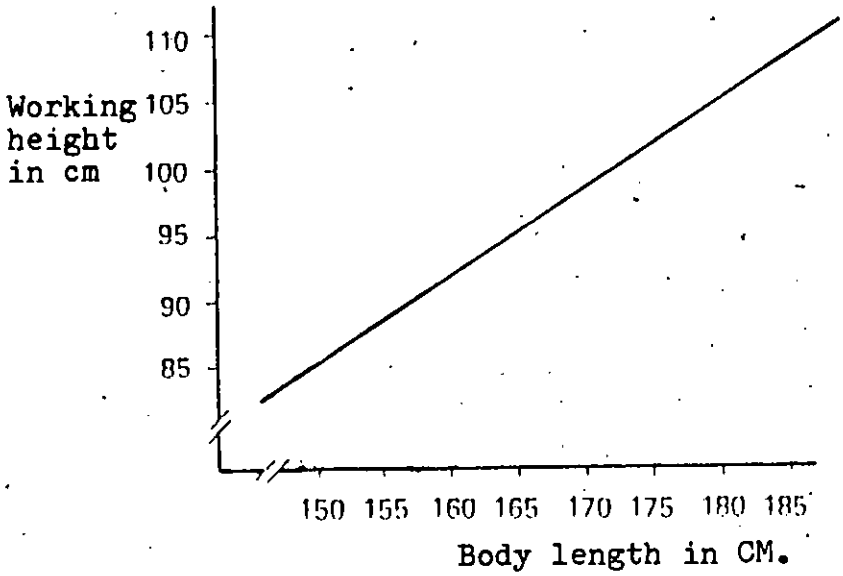


Figure-5.2.1 (b) : Working heights for light work while standing in relation to human body length.

5.2.2 Seating at Work

A. In many work stations, some jobs are performed by the workers in sitting position. Workers usually use bench for sitting arround a table. Given below are the name of the sections and the height of the benches that are presently in use.

Table-5.2.2 (a) : Existing working heights of tables while sitting.

Sl.No.	Section	Table Height (in cm)
1	Snow (in tube) Tooth Paste	74
2	Snow (in bottle)	
	Packing (one dozen)	78
	Levelling bottle	80
3	Powder	78
4	P_1/P_2 Plant (Blue Bar soap production)	63
5	P_3 Plant (Toilet soap production)	59
6	P_4 Plant 570 Washing soap production	70

Table-5.2.2 (b) : Existing heights of benches while sitting

Sl.No.	Section	Table Height (CM)
1	Snow (in tube) Tooth Paste	56
2	Snow (in bottle)	
	Packing (one dozen)	56
	Levelling bottle	63
3	Powder	56
4	P_1/P_2 Plant (Blue Bar soap production)	56
5	P_3 Plant (Toilet soap production)	59
6	P_4 Plant 570 Washing soap production	56

It is clear from the above tables that the working tables/ benches heights are not compatible with the standard heights. It is observed from the above data that the table height while working in standing position and table height while working in sitting position is almost same. In some

section where jobs are performed in standing position the required table height is lower than the table height for sitting position.

These unusual heights of table/benches causes spinal pain and excessive muscle stress. To improve the sitting position these fixed height type table/bench should be replaçed by adjustable height type bench so that each worker can select his most comfortable height for seated work.

The ideal table heights for assembly work and comfortable inclination of vision when standing and when sitting down are shown in Figure-5.2.2(a) and (b) (4).

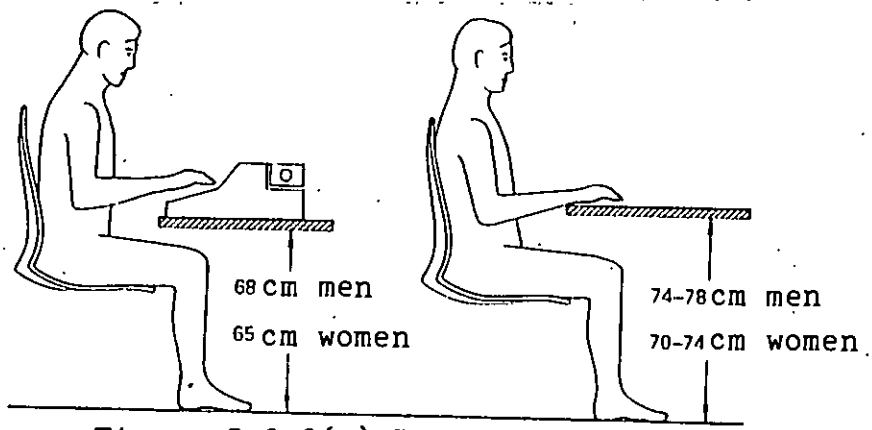


Figure-5.2.2(a) Recommended table heights for sedentary work.

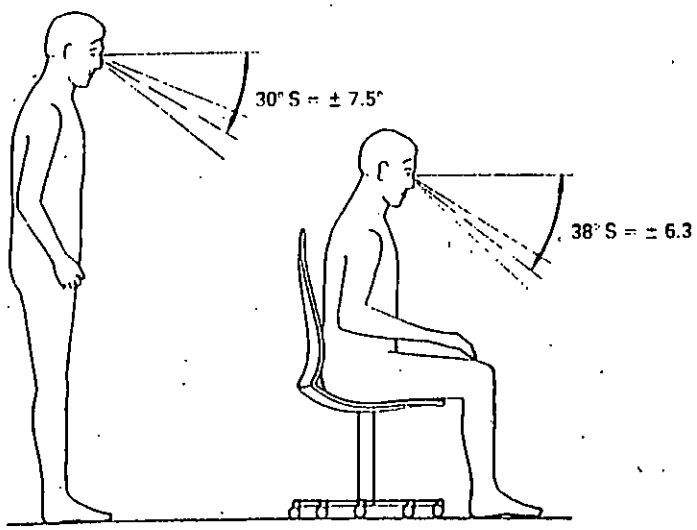


Figure-5.2.2(b) Comfortable inclination of vision when standing (left)& when sitting down(right).S=standard deviation.

B. In soap section tapping and wrapping jobs are performed on the floor. Workers seated on the floor for tapping and wrapping of six dozen cartoons continuously. This type of working position causes back pain. This working position should be reorganised to make the job comfortable for the workers. For this purpose the job should be done on a standard table (Ergonomic Standard) which will certainly increase the working ability of the worker and thus will improve the productivity of the Soap Processing Section.

C. In 570 soap section, a worker has to bend for doing nailing job. This position of working causes excessive stress in the spinal cord as well as energy consumption of the body increases.

If the packing table of 570 washing soap manufacturing is extended to do the nailing job on the same table then these problems for the workers could be eliminated.

D. In Toilet Soap Processing Section (P_3), the workers fill six dozen cartoons which are kept by their sides sitting on one side of the table resulting in awkward twisting and motions of his body and limb. Existing table may be replaced by a narrow inclined slide for avoiding workers body and limb motion problems.

5.3 HANDLING LOADS

5.3.1 Existing Loads Handling Methods

(a) Most of the transportation of Raw Materials and products during production are transported manually from one work station to another. In mixing section raw materials and drum handling are done manually in a improper way. Workers do not follow the right procedure of lifting products. They bend their back and keep their knees straight. This body posture of lifting weight put a much greater stress on the discs in the lumber region than keeping the back as straight as possible and bend the knees. The ideal manual material handling procedures are shown in Figure-5.3.1; 5.3.2 and 5.3.3. (4).

To avoid physical problems during work and material handling, the workers should follow the correct procedures. An ideal manual material handling procedure is presented in figure-5.3.4 for different type of transportations (5).

(b) In powder processing section feeding of raw materials into crusher's hopper is done manually. The worker has to climb a wooden strair case carrying the raw materials over his head and then pour it into the hopper as it is beyond the reach of a worker. It should be mentioned here that the height of the hopper is 3 meter. Such loading of hopper is very dangerous and may cause accident at any time. This present method of feeding of raw material could be avoided if a conveyor belt is installed for feeding. This will certainly decrease the loading time as well as it will ensure safety to the worker.

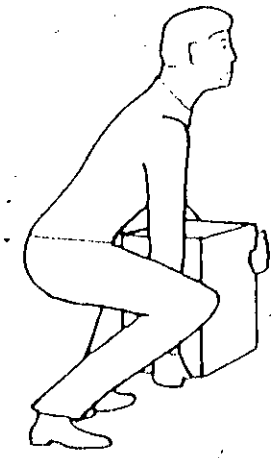


Figure-5.3.1. LIFT LOADS AS CLOSE TO THE BODY AS POSSIBLE

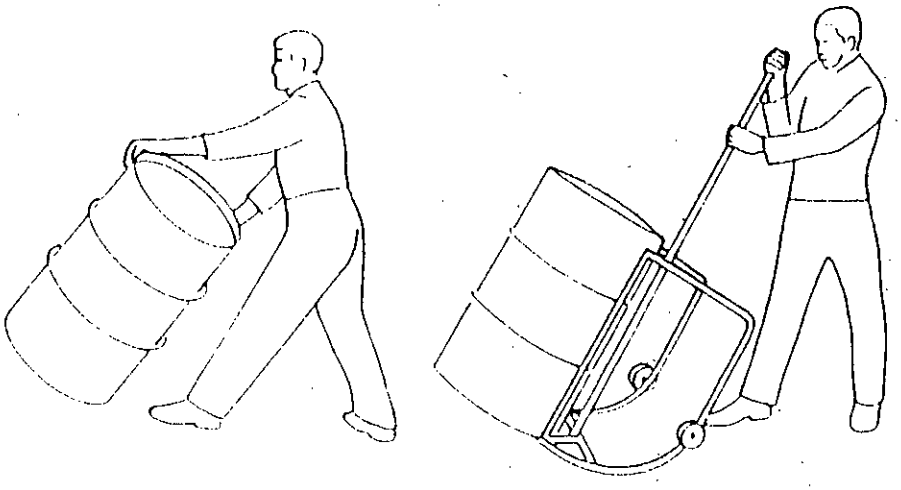


Figure-5.3.2. Handling casks. Left: tilting and rolling, with the upper part of the body held upright.
Right: lightening the work by using a trolley.

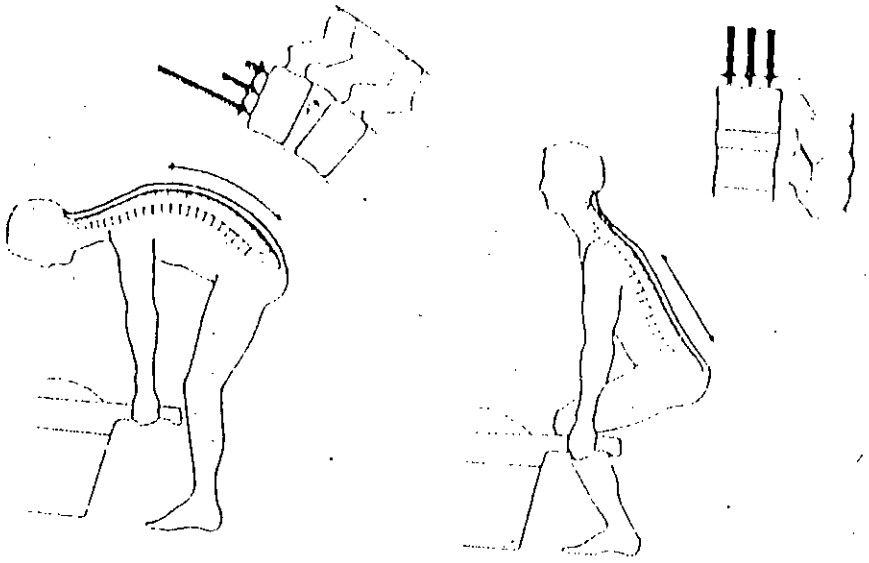
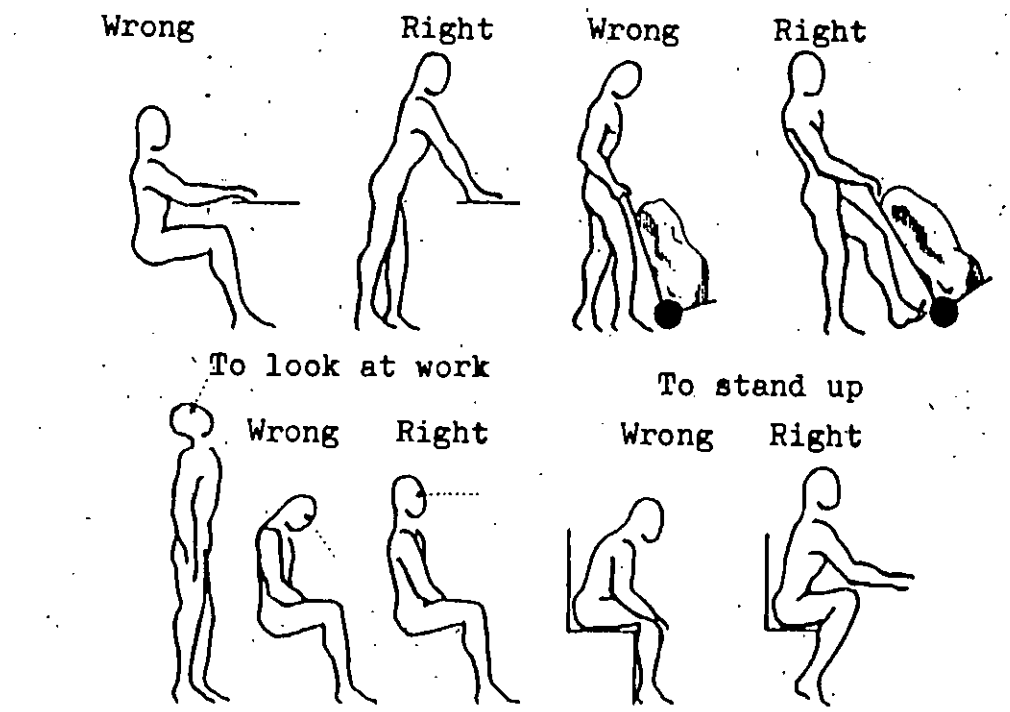


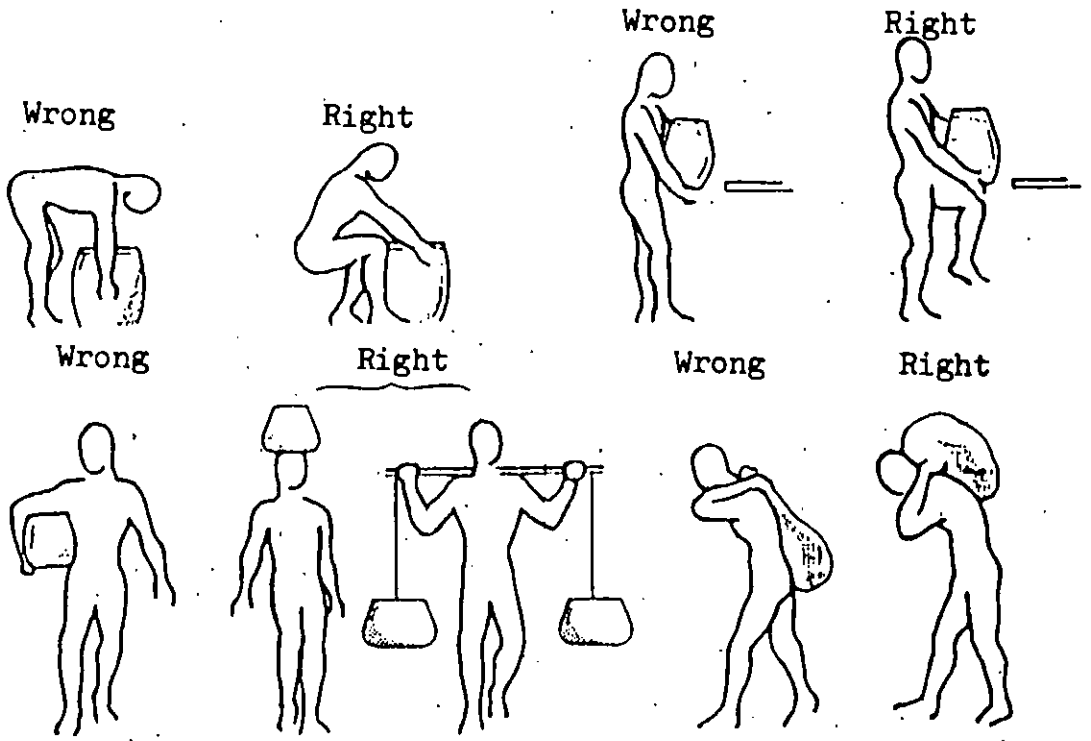
Figure- 5.3.3. How the pressures on the intervertebral discs are distributed when a load is being lifted, with bent, and with straight back.

Figure-5.3.4.: OPTIMAL USE OF PHYSICAL EFFORT

A. ASPECTS OF WEIGHT DISTRIBUTION



B. LIFTING AND CARRYING



(c) In Snow and Tooth paste section, the mixed raw materials are transported from mixing to filling section in a container by manual transportation. Two workers lift the heavy container together and then carry it to the required place. This carrying process requires much greater efforts as well as physical stress and results in back and hand pain of the worker.

From ergonomical point of view, such transportation of raw materials should be avoided. The present method of transportation could be improved if a trolley is used for transportation.

(d) In general, for work requiring frequenct lifting, it is advisable to use a well trained worker. The correct technique is shown in Figure-5.3.4.

5.3.2 Manual Material Handling (MMH)

Manual Material Handling alone is the cause of about 25-30% of all industrial injuries. Related injuries include over-exertion, crushing, dropping, sprains and falls.

To minimize the risks and severity of the MMH over-exertion injuries, it is essential to pursue an ergonomic approach to the design of MMH tasks. In the design of such tasks, ergonomics gives utmost consideration to the human anatomical, physiological and psychological capabilities and limitations (10).

There are many factors involved in MMH. Consequently no one approach will ever solve the whole problem but four general approaches can be considered. Any specific solution will involve a mixture of these. These four approaches are to modify or make allowances for:

i) <u>The object:</u>

Grip	:	Objects should be easy to grasp To use handles or handholds
Size	:	To avoid large objects which extend the arms and impede vision.
Weight	:	Maximum 25 kg for man and 15 kg for women
Centre of gravity	:	To avoid lopsided weights and loose contents
Markings	:	To mark total weight clearly. To mark all dangerous substances.

ii) <u>The task:</u>

Height	:	To keep all repetitive lifts between knuckle and shoulder height.
Duration	:	Keen carrying to a minimum.
Rate	:	To avoid high lifting rates.
Upper Body: Movement		To minimize upper body movement.
Accuracy of placement	:	Accurate placement increases static muscular demands.

iii) <u>The Environment:</u>

Temperature:		To avoid heat and extreme cold.
Friction	:	To avoid changes in surfaces such as sticky or slippery floors.
Lifting space	:	To avoid constricting spaces.
Footing	:	To avoid awkward footing areas such as pallets.

iv) The Operator:

Screening	:	To avoid stressing previous injuries.
Training	:	To teach correct lifting. To make allowances for inexperience. To teach personal limits in strength and endurance.
Fitness	:	To encourage physical fitness. To make allowances after illness or absence.
Age	:	Older people are more vulnerable to heat and fatigue.

The first priority should be given to modify the object, the task or the environment. Even quite simple modifications can have far reaching effects. For example (Figure-5.3.5) putting handholds on containers and boxes will: (9).

- make them less likely to be dropped
- demand less static muscle activity when carrying.
- make grasping easier and quicker
- reduce the amount of upper body lifting and lowering.

The upper body weights a great deal - 35 kg or more. Every time this weight is lifted or lowered it costs energy and stresses the spine, just like any other weight. Small reductions in the frequency or the range of upper body movement can mean appreciably less fatigue and less stress (10).

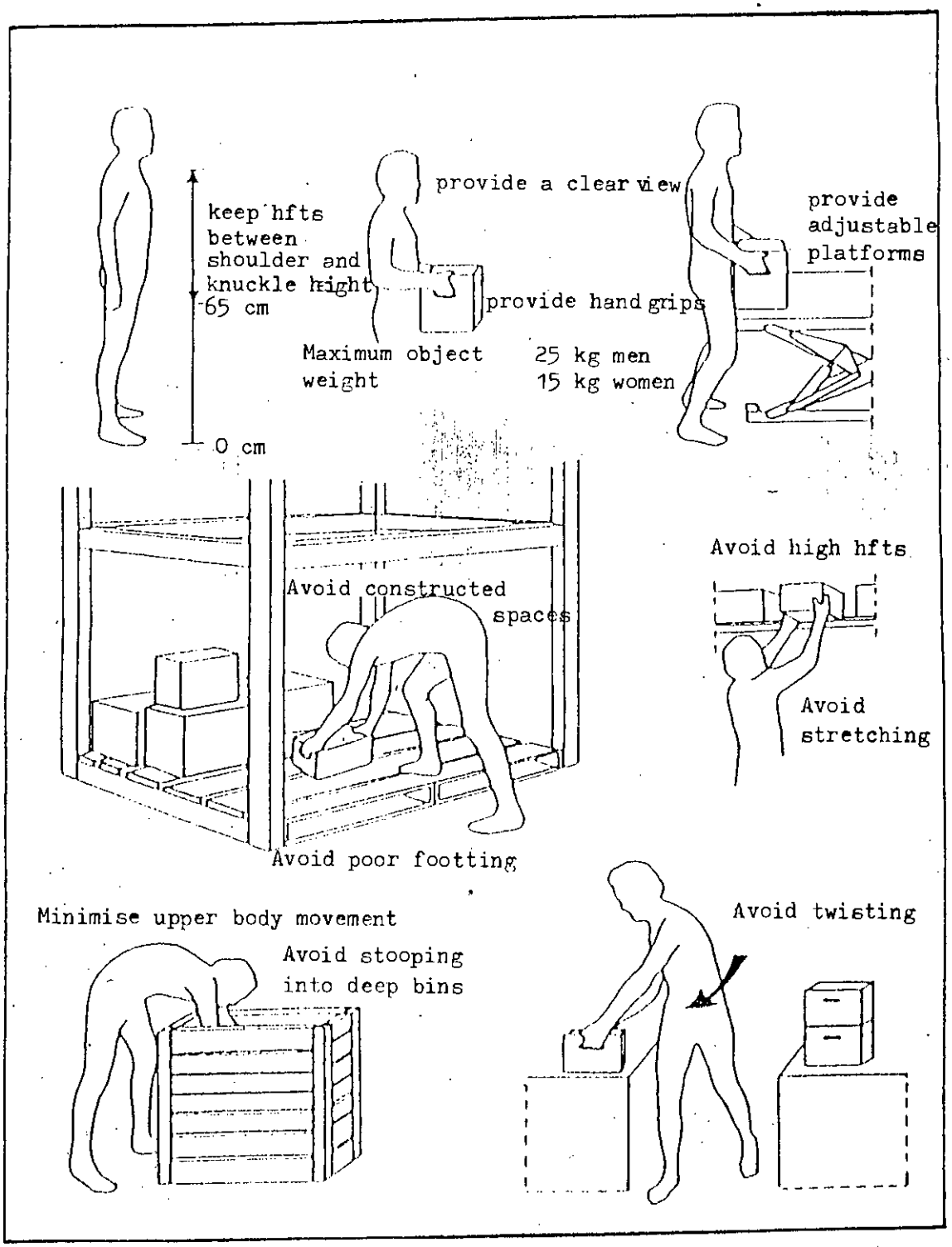


Figure-5.3.5. Manual material handling procedure.

5.4 HAND TOOLS AND DEVICES

The hand tools (like hammer, screw driver, cutting pliers, wrench, knife, etc.) that are being used by the technical staffs for last 32 years are not designed ergonomically. While designing these tools some factors like tissue compression stress, repetitive finger action, design for safe operation, maintain of a straight wrist, etc. were not considered. So, for smooth performance and for safe operation these tools should be replaced by new ergonomically designed tools as shown in Figures (8).

Wrist joint movement and elbow joint of human hand are shown in figure-5.4.1 and 5.4.2. The short-comings of the old tools may be described as follows:

i) They are hard to hold in hand
ii) Handles are too far apart to squeeze
iii) Too heavy to handle
iv) To hard to squeeze and
v) Awkward.

Figure-5.4.3; 5.4.4; 5.4.5; and 5.4.6 show the differences between old tools and new tools (8).

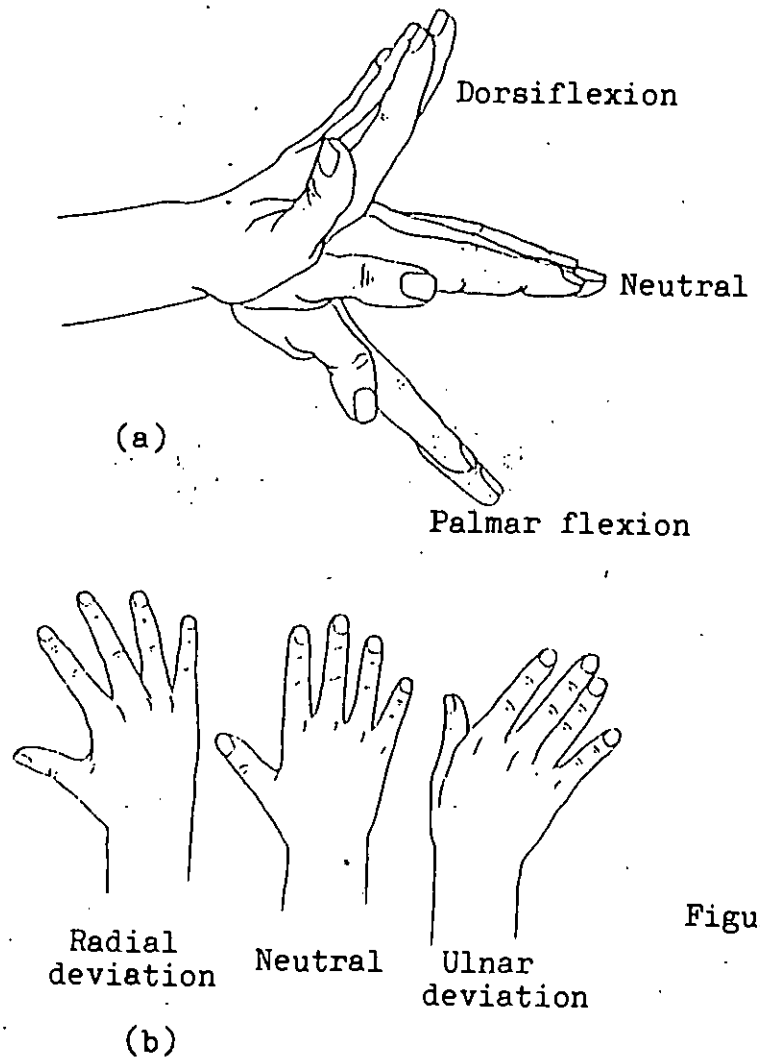
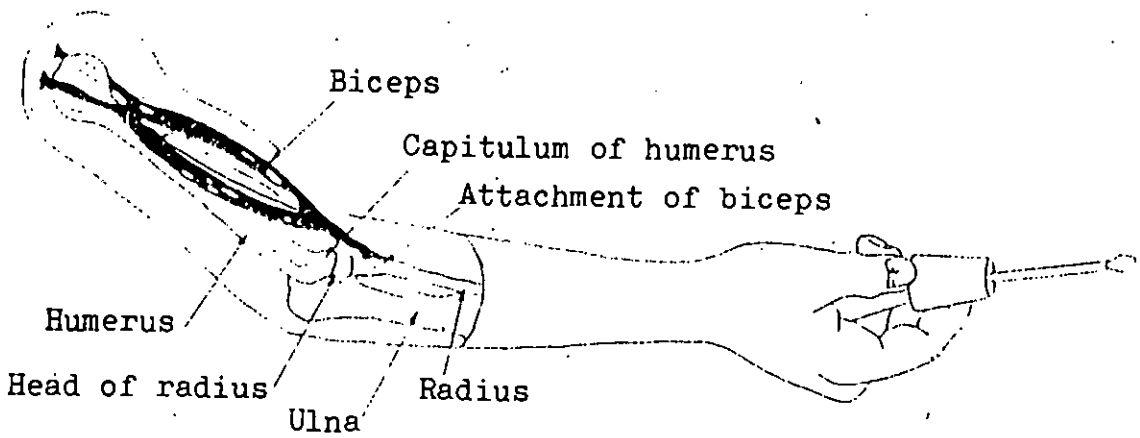
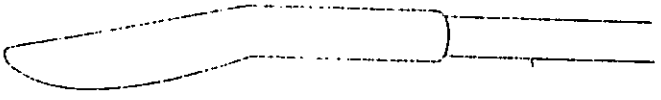


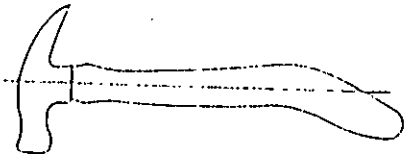
Figure-5.4.1.: Movements of the wrist joint about two axes.

Figure-5.4.2.: The elbow joint showing the connection of the bicep to the redius.



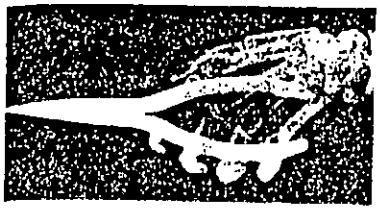


(a) Broom handle



(b) Hammer handle

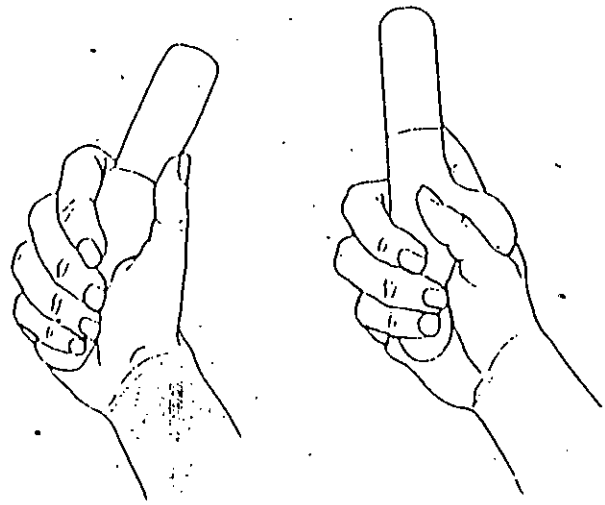
Figure-5.4.3 : Examples of the Bennett handle that helps the user keep the wrist straight while using the tool.



(a) Conventional design (b) Redesigned pliers

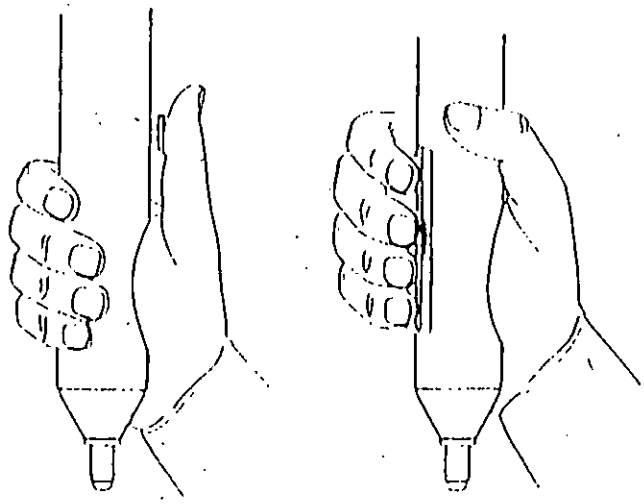
Figure-5.4.4 : X-rays of hand using conventional pliers in a wiring operation, (a) and in using a redesigned model (b), The redesigned model is more anatomically correct.

Due to improper design of hand tools injuries occur frequently. Other more incidious consequences of improper tool design are cumulative trauma such as tenosynovitis, "trigger finger", ischemia, vibration-induced white finger, and even tennis elbow. These conditions usually do not show up on accident injury reports but often lead to reduced work output, poor quality work, increased absenteeism and single incident traumatic injuries.



(a) Coventional handle (b)Modified handle

Figure- 5.4.5.: A conventional paint scraper that presses on the ulnar artery and a modified handle which rests on the tough tissues between thumb and index finger, thus preventing pressure on the critical areas of the hand.



(a) Thumb switch (b) Recessed finger strip

Figure- 5.4.6. : Thumb-operated and finger-strip-operated pneumatic tool. Thumb operation results in overextension of the thumb. Finger-strip control allows all the fingers to share the load and the thumb to grip and guide the tool.

5.5 WORKING ENVIRONMENT

(a) Lighting and Ventilation

The KCCL was constructed about 32 years ago.During designing little care was taken for lighting and ventilation. As a result every section suffer from insufficient light as well as poor ventilation. This problem is very serious in powder section. Due to poor lighting excessive stress is put on their eyes which causes eye fatigue. In sufficient light may cause accident. Improper ventilation causes breathing problems and make the atmosphere unhealthy for the workers. This two factors certainly decreases workers efficiency. Standard lighting and ventilation system has to be maintained in every production section according to industrial law of Bangladesh.

Some modification is needed for natural lighting and ventilation specially in powder and snow sections. Generally it could be said that the roof of all sections should be redesign or replaced for natural lighting and exhaust fans should be installed for proper ventilation.

(b) Dust

Musk should be provided to the workers of powder section as the atmosphere of this section is hazardous to workers health. Due to crushing, filling and air cleaning, the

atmosphere of this section is always dusty. Inhaling such dusty air, causes lungs problem. As the workers of this section works without musk, most of them suffer from asthma.

(c) Humidity

Humidity also has a great affect on workers. In snow, tooth paste and powder section, walls and floors are wet due to poor ventilation and humidity. To maintain a hyegenic and good working condition normal humidity should be maintained in every section.

(d) Colour

The equipments, machineries and vessels are not appropriately coloured. The colours of some vessels and equipments put stress on workers eyes who work on them. So, these machineries, equipments and vessels should be repainted keeping in mind the ergonomical suggestions of colouring equipment and machinery.

5.6 MOVEMENTS OF HUMAN BODY AT THE WORKPLACE

a) In most of the work stations various jobs are done on tables. Several workers stand or sit around a table/bench and perform their jobs. The existing table length, number of workers, recommended number of workers as per ergonomical approach are presented in the following table:

Table-5.6 (a) : Existing working table length for seated works and recommended number of workers as per ergonomical approach.

Sl.No.	Section	Table Length (cm)	No. of workers allocated (both side)	Recommended number of workers
1	Snow (in tube)	488	17	8
	Tooth Paste		25	10
2	Snow (in bottle) Cleaning and capping, etc.	512	20	8
	Levelling and Packing	430	18	6
3	Powder	316	10	4

It was found that the working space on the table is very inadequate for the worker. Some workers sit idle while others work due to insufficient working space.

An ideal working space is shown in Figure-5.6(a) (4).

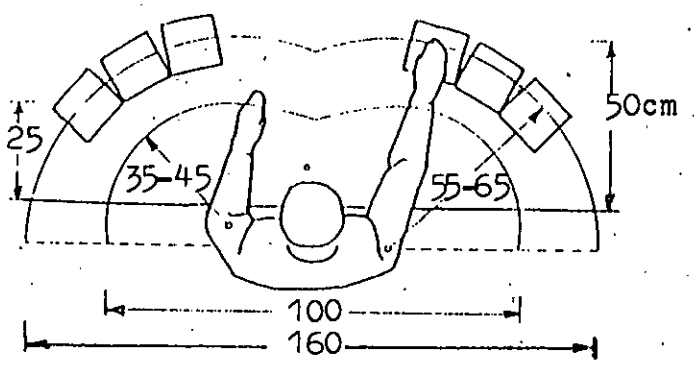


Figure-5.6 (a)
Horizontal arc of grasp, and working area at table top height. The grasping distance takes account of the distance from shoulder to hand; the working distance only elbow to hand. The values include the 5 percentile and so apply to men and women of less than average size.

From ergonomics point of view the recommended number of workers for each table are determined and are presented in table-5.6(a). This step will certainly increase the working efficiency.

(b) While working on a table, workers move their hands not symmetrically. They make excessive perallel movement, twist their hands unnecessarily which result in excessive energy loss. These unnecessary hand and body movement make them tired faster and sometime causes muscle pain. These unnecessary movements are not in favour of motion economy and so these should be avoided. The normal and maximum working area as well as the hand movements of a worker should be as shown in diagrams 1 and 2 of Fig.5.6 (b) (5).

Diagram 1. NORMAL WORKING AREA
Finger, Wrist and Elbow Movements

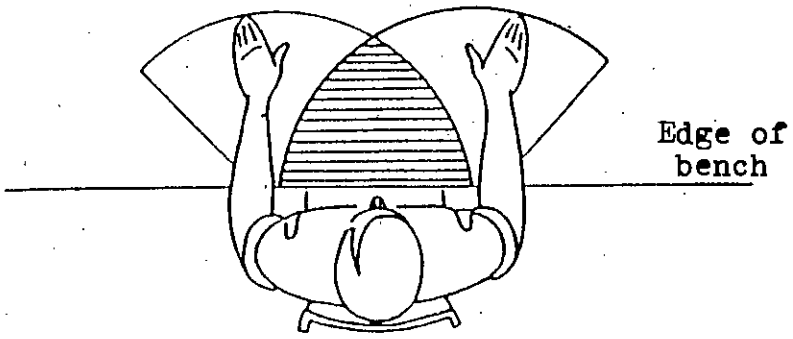


Diagram 2. MAXIMUM WORKING AREA
Shoulder Movements

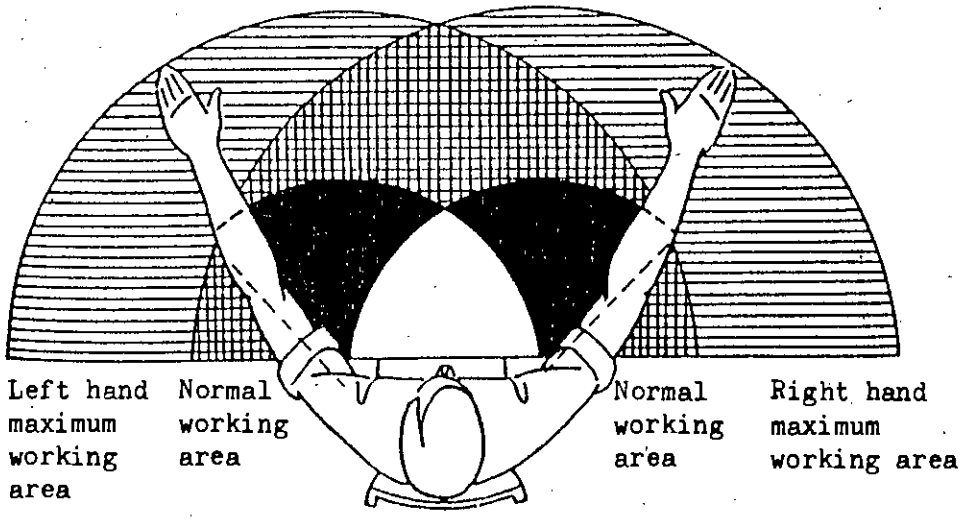


Figure-5.6 (b). Normal & maximum working areas.

Some points are given below from the motion economy point of view to over-come these problems:

A. Use of Human body

When possible;

i) the two hands should begin and complete their movements at the same time.

ii) the two hands should not be idle at the same time except during periods of rest.

iii) motions of the arms should be symmetrical and in opposite directions and should be made simutaneously.

iv) hand and body motion should be made at the lowest classification at which it is possible to do the work satisfactorily.

v) momentum should be employed to help the worker but should be reduced to a minimum whenever it has to be overcome by muscular effort.

vi) continuous curved movements are to be preferred to straight line motions involving sudden and sharp changes in direction.

vii) free-swinging movements are faster, easier and more accurate then restricted or controlled movements.

viii) rhythm is essential to the smooth and automatic performance of a repetitive operation. The work should be arranged to permit easy and natural rhythm whenever possible.

ix) work should be arranged so that eye movements are confined to a comfortable area, without the need for frequent changes of focus.

B. Arrangement of the Workplace

i) definite and fixed stations should be provided for all tools and materials to permit bait formation.

ii) tools and materials should be pre-positioned to reduce searching.

iii) tools, materials and controls should be located within the maximum working area and as near to the worker as possible.

iv) materials and tools should be arranged to permit the best sequence of motions.

v) provision should be made for adequate lighting and a chair of the type and height to permit good posture should be provided. The height of the workplace and seat should be arranged to allow alternate standing and seating.

vi) the colour of the workplace should contrast with that of the work and thus reduce eye fatigue.

C. Design of Tools and Equipments

i) the hands should be relieved of all work of 'holding' the workpiece where this can be done by a jig, fixture or foot-operated device.

ii) two or more tools should be combined whenever possible.

iii) where each finger performs some specific movements the load should be distributed in accordance with the inherent capacities of the fingers.

iv) handles such as those on cranks and large screw drivers should be so designed that as much of the surface of the hand as possible can come into contact with the handle.

v) levers, crossbars and handwheels should be so placed that the operative can use them witht the least change in body position.

5.7 CONCLUDING REMARKS

The conclusions of the above investigation are stated below:

1) Ergonomic approach towards works goes beyond the mere protection of the workers physical integrity. It ensures workers wel-being through the attainment of optimal working condition. In view of this, some applications of ergonomics are suggested in this chapter. These suggestions should be considered and eliminate existing methods. This will certainly ensure safety and wel-being of workers as well as it will lead to higher productivity.

2) An ergonomic approach to the design of MMH jobs and workplace appears to be the most promising engineering solution to minimize the incidence of occupational injuries. Such an approach will ensure that the MMH tasks are performed within human tolerance limits.

Chapter — VI

CALCULATIONS OF MANPOWER REQUIREMENT

6.1 ACTIVITY SAMPLING TECHNIQUE

Activity Sampling Technique was used to determine the required manpower in the cosmetic and soap manufacturing sections, because in these plants workers are engaged in groups. Activity sampling technique is very applicable in determining work volume accomplished by a group.

As a part of this technique workers are carefully observed at different work stations. After observing them in working condition or in idle condition during working time, workers activity ratio was calculated.

By using universal formula of sample size calculation, the minimum number of observation was calculated and is shown in Appendix-L. The next step was to calculate the percentage of relaxation allowances and leave and absenteeism rate of last one year and thus the correct manpower requirement at every work stations was determined.

Basic informations of manpower calculations are:

i) Present manpower allocation (shown in Appendix-Q).

ii) Percentage of working time (shown in Appendices - E and F).

iii) Relaxation allowances (shown in Appendix-B);

iv) Percentage of leave and absenteeism (shown in Appendices - O and P);

v) Manpower requirement of every work station (Appendix-D);

vi) Summary of recommended manpower per shift (Appendix-C);

vii) Final statement of existing and proposed manpower requirement and expected output (shown in Appendix-A).

6.2 TIME STUDY TECHNIQUE

To determine the manpower requirement, balance and expected output of different work stations of step by step manufacturing process, measuring productivity of different steps (for machine controlled work)/workers productivity (for manual work) is required.This was done by applying time study technique. In this method accomplishing time of different works by workers or output rate of different machines were determined. Also expected output for possible work stations were determined after calculation of cycle time.

Example : Time required by a worker to fill a cartoon or quantity of products produced by a worker per minute.

First, all the production lines were carefully observed and ineffective elements in the methods were eliminated from the process by method study. Then all the informations available about the jobs were recorded. Essential time study equipments were used for time study. Observed times by stop watch time study method were recorded. All data concerning time study technique of cosmetic processing plant are shown in Appendices - J and K. Existing base part mixing times were also recorded and are shown in Appendix-M.

After observation, the observed time was converted to basic time by applying basic mathematical equation No.[2].

The British standard scale was used in this study which is the 0 - 100 scale. In calculat the standard time, the standard rating of the scale was considered to be 100 which meant by the operators/workers work briskly/business like performance, all through over the working hour.

Standard time was calculated by adding percentage of relaxation allowances with the basic time for every work stations and groups in the processes (equation No.[3]). Finally cycle time for a complete process was also calculated which are shown in Appendix-I.

Basic informations of manpower calculations are:

i) average observed time; (shown in Appendices - J and K);

ii) basic time and standard time (shown in Appendices - I and J);

iii) complete cycle time of the process (shown in Appendix-I);

iv) output rate of each section (shown in Appendix-H);

v) required manpower calculation (shown in Appendix-G).

Calculation of manpower requirement on the basis of time study through production line balancing is given in Appendix-G. For the above, output rate of each section was calculated considering 5% average down time for electrical and maintenance failure and 7.5 hours working time per shift.

6.3 SUMMARY:

It may be mentioned here that in recommending the requirement of actual number of manpower, the Activity Sampling Technique results were considered since this gives better results than time study technique. Since the current manpowr is much higher, the number of manpower calculated by the Work Sampling method would be better acceptable by the management. Therefore, manpower requirement in KCCL may be recommended from the Work Sampling Technique. As a result the workers are supposed to work at a steady rate and unhurried performance with time not being intentionally wasted.

Chapter – VII

PROCESSING OF DATA AND RESULTS

7.1 PROCESSING OF DATA

The main purpose of analysing activity sampling data and time study through production line balancing was to calculate required manpower. It has been already mentioned that activity sampling technique was applied on three groups separately in cosmetic and soap processing plants. All data concerning these techniques are shown in Appendices - E and F. After observation percentage of activity of every work station and group was calculated separately. Calculation of manpower requirement at every work station of cosmetic and soap processing plants work sampling technique adding relaxation allowances and leave and absenteeism rate are shown in Appendix-D. Calculations were also made seperately for production and technical workers.

The summary of recommended manpower per shift are shown in Appendix-C.

Final statement of existing and proposed employement of manpower and expected output of cosmetic and soap processing plants are shown in Appendix-A.

Analysis of data for calculation of required manpower and expected output rate by time study technique through production line balancing (manpower balance) are shown cronologically in Appendics - G, H, I, J and K.

7.2 LIMITATIONS OF THE STUDY

The main limitations of the study were:

i) this study was confinced only in cosmetic section (allowable area). No investigation was conducted in Perfume area. In Soap Processing Unit the study was confined only in P_1/P_2, P_3 line of Mazzoni Plant and P_4 line.

ii) for determining manpower only Time Study (Stop Watch) and Work Sampling Techniques were used.

iii) to calculate a Standard Time, only the standard rating was considered.

iv) minimum number of observation was considered in between 60-70.

v) to determine manpower requirement by Time Study, output rate of various sections were fixed.

vi) to calculate output rate considering 5% average down time for electrical and maintenance failure and 7.5 hours working time per shift.

vii) in recommending the requirement of actual number of manpower, the Activity Sampling Technique results were considered as it was found higher.

7.3 SUMMARIZED RESULTS

i) Ergonomics Applications

Some applications of ergonomics on the design of existing work places, handling loads, hand tools and devices, working environment and motion economy in cosmetic and soap processing plants have been suggested in Chapter-5.

ii) Production Method Study

About twelve improved/modified production methods and layout in whole cosmetic and soap processing plants have been suggested in Chapter-4.

iii) Manpower

a) About 37% of existing manpower was found to be in excess in cosmetic processing plant (Appendix-A).

b) About 48% of existing manpower is found to be excess in soap processing plant (Appendix-A).

iv) Relaxation Allowances

a)	Cosmetic Processing Plant:	(Appendix-B)
	Technical Side	= 49%
	Packing Side	= 28-31%
	Other Side	= 26%
b)	Soap Processing Plant	(Appendix-B)
	Technical Side	= 25%
	Packing Side	= 25%
	Other Side	= 25%

v) Leave and Absenteeism:

Leave and Absenteeism rate was found 16.99% and 19.83% in cosmetic and soap processing plants respectively (Appendix-O).

vi) Output Per Shift : (Appendices - G and H)

122 Gross of Snow (in tube) by the existing manpower
115 Gross of Snow (in bottle) by the existing manpower.
126 Gross of Powder by the existing manpower.

In cosmetic section the average current output is 41% less than expected output by the existing manpower.

335 Gross of Blue Bar soap (P_1/P_2) by the existing man power
335 Gross of Toilet soap (P_3) by the existing manpower.
590 Gross of 570 Washing Soap (P_4) by the existing manpower

In soap section the average current output is 43% less than expected output by the existing manpower.

vii) Cycle time for filling and packing part : (Appendix-I).

Snow (in tube)	=	2.975 minutes
Snow (in bottle)	=	4.362 minutes
Powder	=	4.061 minutes.

viii) Observed Machine Capacity for full 8 hours operation:

Snow (in tube) production	= 122 Gross where as present production is 70 Gross
Snow (in bottle) production	= 115 Gross where as present production is 80 Gross.
Powder production	= 126 Gross where as present production is 60 Gross.
Blue Bar soap production	= 335 Gross where as present production is 190 Gross.
Tioler soap production	= 335 Gross where as present production is 170 Gross.
570 washing soap production	= 590 Gross where as present production is 360 Gross.

Chapter – VIII

CONCLUSIONS AND RECOMMENDATIONS

8.1 CONCLUSIONS

Tbe conclusions of thc present investigation are stated below:

1) The requirement of actual number of manpower obtained by the work sampling and time study methods were about 58% and 41% respectively. Thus the result of work sampling method was about 17% higher than the time study method.

2) From time study and activity sampling, it was found that the existing manpower is almost 42% excess of what is required at the present time. Excess manpower could be utilized elsewhere.

3) The expected output of each section was recommended. The current output of each section is about 43% less than the expected output.

4) Some modifications/improvements concerning production method and material handling have been made. These modifications are expected to improve material/product handling, working condition and above all to improve productivity.

5) Some ergonomical analysis regarding design of work places, handling loads, hand tools and devices, working environment, motion economy etc. will increase job satisfaction of workers, reduce the rate of accidents and raise productivity of the plant.

8.2 RECOMMENDATIONS

On the basis of the experimental results the following recommendations are made:

1) The suggested improved and modified production methods in cosmetic and soap processing plants should be implemented for easy and smooth operation. This will improve the productivity.

2) For improving worker wel-being, safety and efficiency ergonomic principles should be applied.

3) From the study it was clear that in cosmetic and soap section existing manpower is much more than required. Manpower requirement must be calculated using time study/work sampling method.

4) Authority of KCCL must take long term and appropriate measures so that any problem of too much relaxation time allowance does not arise.

5) Day by day working efficiency of workers, technicians, operators are going down as they are not motivated to do the work. For avoiding this there should be provision for various types of training, participation and upgrading of workers, technicians and operators skills.

6) It is recommended that a committee should be formed with personnel from various departments in KCCL to undertake the responsibility of applying Ergonomics to enhance productivity.

8.3 FUTURE RESEARCH

To obtain maximum benefit, research work through Ergonomics Methodology and Work Study Technique should be conducted in the following areas:

1) Redesign of whole process layout and old equipments and machineries according to the principle of Ergonomics to maximise productivity.

2) There is a need to improve and standardize the method of mixing, filling and packing works with the aim to maximise job satisfaction and workers attitude towards the job.

3) Use of computer in information processing activities in order to reduce percentage of error, to decrease stress on human.

4) There is a need to develop MMH standards by employing proper performance/capacity evaluation method and such standards should give due consideration to the weight, size, frequency and the position of the load handled.

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A P P E N D I C E S

STATEMENT OF EXCESS AND REQUIRED MANPOWER

Plants	Percentage of excess manpower	Average percentage of excess manpower	Average percentage of required manpower
	WORK SAMPLING METHOD		
Cosmetic	37%		
		42%	58%
Soap	48%		
	TIME STUDY METHOD		
Cosmetic	50%		
		59%	41%
Soap	68%		

STATEMENT SHOWING EXISTING AND PROPOSED EMPLOYMENT OF MANPOWER AND EXPECTED OUTPUT.

(COSMETIC PROCESSING PLANT)

PLANT / PROCESS		ALLOCATED MANPOWER PER SHIFT / PARTY / DAY.		RECOMMENDED MANPOWER PER SHIFT/PARTY/DAY			RECOMMENDED EXPECTED OUTPUT (Single Line) for full 8 hours' operation. Gross, (12 - Dozen)	REMARKS
P R O D U C T	SINGLE LINE PRODUCTION PER PARTY. GROSS. (12 - DOZEN)	FILLING & PACKING PART.	B A S E P A R T	FILLING & PACKING P A R T	B A S E P A R T	SUPERVISOR		
SNOW (TUBE)	70	19	8	13				
TOOTHPASTE	103 / 65	27	9	*		1	122	
SHAVING CREAM	60	18	9	*	** 6			
SNOW (BOTTLE)	80	40	9	25				About 37% of existing manpower is found to be excess.
CREAM (POMMET)	60	18	7	*		1	115	
POWDER	95 /60	11	8	8	** 6	1	126	
COMMON IN WHOLE COSMETIC SECTION		4 (TECHNICAL STAFF)		FOREMAN - 1 TECHNICAL STAFF - 2 TRANSPORTATION & WASTE DISPOSAL - 2 OTHER WORKERS - 2				

* THESE ARE NOT STUDIED.

** OBSERVATION WAS NOT DONE. THE RECOMMENDATION ON THE BASIS OF OWN UNDERSTANDING ABOUT THE JOB.

STATEMENT SHOWING EXISTING & PROPOSED EMPLOYMENT OF MANPOWER

(SOAP PROCESSING PLANT)

PLANT/PROCESS		ALLOCATED MANPOWER PER SHIFT		RECOMMENDED MANPOWER PER SHIFT				REMARKS
		CARTOON	PETTY	CARTOON	PETTY	SUPERVISOR	FOREMAN	
P1/P2	OPERATIONAL WORKER	24	24	12+3	15+3	1	WASHING SOAP: 1 TOILET SOAP: 1	About 48% of existing manpower is found to be excess.
	TECH. STAFF	6	6	2	2			
P3	OPERATIONAL WORKER	37	-	17	-	1		
	TECH. STAFF	12	-	6	-			
P4	OPERATIONAL WORKER	37	47	17	19	1		
	TECH. STAFF	6	6	3	3			
COMMON FOR ALL PLANTS	-	5 (WORKER)		PERFUME/ CHEMICAL: 2(Tech.Staff) OTHERS : 2 (Worker)				

STATEMENT OF MANPOWER REQUIREMENT BY TIME STUDY METHOD

Sections	Allocated Manpower	Total Allocated Manpower	Recommended Manpower	Total Recommended Manpower	Percentage of excess Manpower
COSMETIC PLANT					
Snow (in tube)	19		10		
Snow(in bottle)	40	70	14	33+2	50%
Powder	11		9		
SOAP PLANT					
Blue Bar(P1/P2)	24		8		
Toilet (P3)	37	98	10	29+2	68%
570 Washing(P4)	37		11		

STATEMENT OF OUTPUT PER SHIFT BY EXISTING MANPOWER

Sections	Present output (gross)	Expected output (gross)	Percentage of present output less than expected output	Average percentage of output
Cosmetic Plant				
Snow (in tube)	70	122	42%	
Snow (in bottle)	80	115	30%	41.3%
Powder	60	126	52%	
Soap Plant				
Blue Bar (P1/P2)	190	335	43%	
Toilet (P3)	170	335	49%	43.7%
570 Washing (P4)	360	590	39%	

A. CALCULATION OF TIME ALLOWANCES FOR SNOW (IN TUBE)/TOOTH PASTE/ SHEAVING CREAM PLANT

	MIXING, FILLING & STORAGE TANK (TECH. SIDE)		PACKING		OTHERS		REMARKS
PERSONAL NEEDS :		10%		10%		10%	ALLOWANCES WERE DETERMINED ON THE BASIS OF ILO RECOMMENDATIONS FOR VARIABLE ALLOWANCES IN POINT SYSTEM CONVERTED TO PERCENTAGE OF TIME. (Ref: Introduction to Work Study, ILO. Geneva, 3rd Revised Edition).
BASIC FATIGUE :		5%		5%		5%	
VARIABLE ALLOWANCES FOR:	POINTS	PERCENTAGE	POINTS	PERCENTAGE	POINTS	PERCENTAGE	
- Posture	4		4		2		
- Physical strain	43		9		-		
- Vibration	1		-		-		
- Concentration	5		-		-		
- Eye strain	-		-		2		
- Noise	2		2		2		
- Temperature and humidity	6		-		-		
- Ventilation	3		3		3		
- Fumes	-		-		-		
- Dust & dirt	-		-		-		
- Wet	2		2		2		
	66	34%	20	13%	11	11%	
		49%		28%		26%	

B. CALCULATED LEAVE & ABSENTEEISM RATE FOR COSMETIC PROCESSING PLANT IN 1989-90 = 16.99%

CALCULATION OF TIME ALLOWANCES FOR SNOW (IN BOTTLE) PLANT

	MIXING, FILLING & STORAGE TANK (TECH. SIDE)		PACKING		OTHERS		REMARKS
PERSONAL NEEDS:		10%		10%		10%	ALLOWANCES WERE DETERMINED ON THE BASIS OF ILO RECOMMENDATIONS FOR VARIABLE ALLOWANCES IN POINT SYSTEM CONVERTED TO PERCENTAGE OF TIME. (Ref: Introduction to Work Study, ILO. Geneva, 3rd Revised Edition).
BASIC FATIGUE :		5%		5%		5%	
VARIABLE ALLOWANCES FOR:	POINTS	PERCENTAGE	POINTS	PERCENTAGE	POINTS	PERCENTAGE	
- Posture	4		4		2		
- Physical strain	43		15		-		
- Vibration	1		-		-		
- Concentration	5		-		-		
- Eye Strain	-		-		2		
- Noise	2		2		2		
- Temperature and humidity	6		-		-		
- Ventilation	3		3		3		
- Fumes	-		-		-		
- Dust & dirt	-		-		-		
- Wet	2		2		2		
	66	34%	26	14%	11	11%	
		49%		29%		26%	

CALCULATION OF TIME ALLOWANCES
FOR POWDER PLANT

	MIXING, DRUM FILLING AND CONTAINER FILLING (TECH. SIDE)		PACKING		OTHERS		REMARKS
PERSONAL NEEDS :		10%		10%		10%	ALLOWANCES WERE DETERMINED ON THE BASIS OF ILO RECOMMENDATIONS FOR VARIABLE ALLOWANCES IN POINT SYSTEM CONVERTED TO PERCENTAGE OF TIME. (Ref: Introduction to Work Study, ILO. Geneva, 3rd Revised Edition).
BASIC FATIGUE :		5%		5%		5%	
VARIABLE ALLOWANCES FOR:	POINTS	PERCENTAGE	POINTS	PERCENTAGE	POINTS	PERCENTAGE	
- Posture	4		4		2		
- Physical strain	46		18		-		
- Vibration	1		-		-		
- Concentration	1		1		2		
- Eye strain	-		-		2		
- Noise	2		2		2		
- Temperature and humidity	6		-		-		
- Ventilation	3		3		3		
- Fumes	-		-		-		
- Dust & dirt	1		1		1		
- Wet	2		2		2		
	66	34%	31	16%	14	11%	
		===		===		===	
		49%		31%		26%	

DETERMINATION OF ALLOWANCES FOR SOAP PROCESSING PLANT

A.

	CRUTCHER & FEED TANK (TECH.SIDE)		PACKAGING		OTHERS		REMARKS
PERSONAL NEEDS :		10%		10%		10%	ALLOWANCES WERE DETERMINED ON THE BASIS OF ILO RECOMMENDATIONS FOR VARIABLE ALLOWENCES IN POINT SYSTEM CONVERTED TO PERCENTAGE OF TIME. (Ref: Introductio to Work Study, ILO. Geneva, 3rd Edition).
BASIC FATIGUE :		4%		4%		4%	
VARIABLE ALLOWANCES FOR:	POINTS	PERCENTAGE	POINTS	PERCENTAGE	POINTS	PERCENTAGE	
- Temperature	6						
- Physical Strain	- - - - - - - -		6				
- Noise - - - -	2 - - - - - -		2 - - - - - - - -		2		
- Posture - - -	4 - - - - - -		4 - - - - - - - -		4		
- Eye Strain					2		
	12	11%	12	11%	8	11%	
		=====		=======		========	
		25%		25%		25%	

B. CALCULATED LEAVE & ABSENTEEISM RATE FOR SOAP PROCESSING PLANT IN 1989 = 19.83%

SUMMARY OF RECOMMENDED MANPOWER PER SHIFT PER PARTY(DAY)
COSMETIC PROCESSING PLANT

SL. NO.	WORK STATION/LOCATION (BRIEF DESCRIPTION)	SNOW (TUBE) PLANT		SNOW (BOTTLE) PLANT		POWDER PLANT		COMMON FOR ALL PLANTS
		Filling & Packing Part	Base Part	Filling & Packing Part	Base Part	Filling & Packing Part	Base Part	
A	B	C	D	E	F	G	H	I
1.	Filling & Belt cleaning/Filling & Cap Placing/Filling, weighing & Inspection	2	-	4	-	2	-	
2.	Packet ready & stamping/straighting and cartoon ready/container cleaning & petty opening	2	-	3	-	2	-	
3.	Inserting tube/cap putting/cap fitting	2	-	3	-	2	-	
4.	Packet closing & arranging/levelling	3	-	5	-	-	-	
5.	Hopper, tube forming, cartoon preparation/ hopper & cleaning bottle	1	-	1	-	-	-	
6.	Packing 1 doz./single packet making	2	-	5	-	-	-	
7.	Final packing/packing 1 doz. and 6 doz.	1	-	4	-	2	-	
8.	Mixing & Transpering to filling section	-	6	-	*	-	6	
9.	Transportation & waste cartoon disposal	-	-	-	-	-	-	2
10.	Other utility services (carpenter, store, lab.,etc.	-	-	-	-	-	-	2
11.	Tech. staff(From base part to packing)	2		2		2		
12.	Supervisors	1		1		1		
13.	Foreman	-		-		-		1

* Base part for snow (In tube) & snow (In bottle) section is common.

SUMMERY OF RECOMENDED MANPOWER PER SHIFT
SOAP PROCESSING PLANT

SL. NO.	WORK STATION / LOCATION (Brief Description)	PLANT PLANT P1/P2 IF (SINGLE ROW EXTRUSION) PAPER CARTOON FILLING 72 pcs per box.	(SINGLE ROW EXTRUSION) Wooden(Petty) Filling 180 pcs per box.	PLANT P4 IF (DOUBLE ROW EXTRUSION) PAPER CARTOON FILLING 72 pcs per box.	(DOUBLE ROW EXTRUSION) WOODEN CARTON FILLING 180 PCS PER BOX	PLANT P3 TOILET SOAP SINGLE EXTRUSION WRAPPING. TAPING	COMMON FOR ALL PLANTS
A	B	C	D	E	F	G	H
1	FEEDING/LOADING DRYER/DRY CHAMBER	2	2	2	2	-	
2	RECEIVING/UNLOADING FROM DRYER(& FILLING BOXES)RECEIVING & STAMPING	3	3	3	3	3	
3	WRAPPING	-	-	-	-	5	
4	PULLING	-	-	-	-	2	
5	TAPING	-	-	-	-	2	
6	FILLING BOXES&PETTY (AFTER STAMPING)	3 *	3*	4	4	-	
7	PACKAGING(Pulling,Taping,Packing, Data,Nailing,Marking etc).	2	5	3	5	-	
8	MAKING & DELEVERY OF EMPTY CARTOONS BOXES(Filling Polythene,Prep,&Supply of Cartoons)	2	2	2	2	2	
9	DUNNAGE & TRANSPORTATION	2	2	2	2	2	
10	WASTE COLLECTION/CLEANING/RECYCLING ETC.	1	1	1	1	1	
11	OTHER UTILITY SERVICES(Carpenter, Store,Lab. etc.						2
12	SUPERVISORS	1	1	1	1	1	
13	TECH.STAFF: a. CRUTCHER/FEED TANK ATTENDENT(Pump/Plant Operator),CUTTER/COLOUR	1	1	2	2	4	2**
	b. STAMPING OPERATOR/WRAPPING	1	1***	1***	1	2	
	c. FOREMAN			1	-	1	

* This manpower is admissible if 570 Washing Soap is produced in this line.
** This manpower is recommeded for COLOUR/PERFUME,for Toilet & Washing Soap.
*** This manpower is admissible only if Stamping m/c is in operation in this line (in case of 570 washing soap).

CALCULATION OF M/P REQUIREMENT
PLANT SNOW (TUBE), FILLING AND PACKING PART. (PRODUCTION STAFF)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING (As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS per shift.	REMARKS
1	2	3	4=Col.2xCol.3/100	5	6=Col.4x1.28	7=Col.6x1.169	8	9
Filling & Belt cleaning	4	24.39%	0.9756	28%	1.249	1.46	2	
Packet ready & stamping	2	52.44%	1.0488	28%	1.342	1.57	2	
Inserting tube	2	45.12%	0.902	28%	1.155	1.35	2	
Packet closing & arranging	4	48.17%	1.9268	28%	2.466	2.88	3	
Making 1 doz. packet	2	51.22%	1.0244	28%	1.311	1.534	2	
Final Packing	2	29.26%	0.5852	28%	0.749	0.876	1	
Hopper, tube forming, cartoon preparation, & waste collection	3	19.51%	0.5853	28%	0.749	0.876	1	
Supervisor							1	One supervisor is recommended for the plant.

CALCULATION OF MANPOWER REQUIREMENT
PLANT SNOW(TUBE) PRODUCTION (TECHNICAL STAFF)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES —	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT.	REMARKS
1	2	3	4=Col.2xCol.3÷100	5	6=Col.4x1.49	7=Col.6x1.1699	8	9
Mixing, filling and storage tank	4	15.85%	0.634	49%	0.945	1.105	2	

CALCULATION OF MAN POWER REQUIREMENT
PLANT SNOW (IN BOTTLE) FILLING AND
PACKING PART (PRODUCTION STAFF)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS per shift.	REMARKS
1	2	3	4=Col.2xCol.3 ÷ 100	5	6=Col.4x1.29	7=Col6x1.1699	8	9
Filling & cap placing	6	40.32%	2.419	29%	3.121	3.566	4	
Hopper & Cleaning bottle	3	21.5%	0.645	29%	0.832	0.973	1	
Packet Oper. & stamping, make straight and cartoon ready	5	38.06%	1.903	29%	2.455	2.872	3	
Cap putting on bottle	4	47.58%	1.903	29%	2.455	2.872	3	
Level wrapping around the bottle	8	39.52%	3.162	29%	4.078	4.771	5	
Single packet making	8	37.1%	2.968	29%	3.829	4.479	5	
Packing of 1 doz. & 6 doz.& placing	6	37.63%	2.258	29%	2.913	3.407	4	
Supervisor							1	One supervisor is recommended for the plant

CALCULATION OF MANPOWER REQUIREMENT
PLANT SNOW (BOTTLE) - TECHNICAL STAFF

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES---	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT.	REMARKS
1	2	3	4=Col.2xCol.3÷100	5	6=Col.4x1.49	7=Col.6x1.1699	8	9
Mixing, filling and Storage tank	4	19.51%	0.7804	49%	1.163	1.36	2	-
Foreman							1	One foreman for whole cosmetic line is recommended

CALCULATION OF MANPOWER REQUIREMENT
PLANT POWDER - FILLING AND PACKING PART (PRODUCTION STAFF)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS per shift.	REMARKS
1	2	3	4=Col.2xCo.3÷100	5	6=Col.4x1.31	7=Col.6x1.169	8	9
Filling, Weighing & Inspection	3	33.33%	0.999	31%	1.309	1.532	2	
Cap fitting	2	60%	1.2	31%	1.572	1.839	2	
Cleaning container, cartoon ready, petty opening & stamping	3	41.33%	1.234	31%	1.624	1.901	2	
Final Packing	3	42.66%	1.279	31%	1.677	1.961	2	
Supervisor	-	-	-	-	-	-	1	One supervisor is recommended for the plant.

CALCULATION OF MANPOWER REQUIREMENT
PLANT POWDER - FILLING & PACKING PART (TECHNICAL STAFF).

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT.	REMARKS
1	2	3	4=Col.2xCol.3÷100	5	6=Col.4x1.49	7=Col.6x1.1699	8	9
Mixing & Filling Machine	4	23.98%	0.9512	49%	1.417	1.658	2	

CALCULATION OF MANPOWER REQUIREMENT COMMON FOR ALL PLANTS OF COSMETICS.

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS per shift.	REMARKS
1	2	3	4=Col.2xCol.3÷100	5	6=Col.4x1.26	7=Col.6x1.1699	8	9
Transportation & Waste cartoon disposal	4 *	21.59%	0.8636	26%	1.088	1.273	2	For convenience of operation 2 workers are recommended for all plants
Other Utility Services	-	-	-	-	-	-	2	
Base part for Snow, Toothpeste & sheaving cream	-	-	-	-	-	-	6	Base part for snow(tube) and snow(Bottle) is same.
Base part for Powder	-	-	-	-	-	-	6	Separate base part
Foreman							1	One foreman for all plants is recommended.

* Activity sampling data sheet for Transportation & waste cartoon disposal were prepared by allocating 4 workers.

CALCULATION OF MANPOWER REQUIREMENT
PLANT P1/P2 FORBLUE BAR SOAP PRODUCTION (WORKERS)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT.	REMARKS
1	2	3	4=Col.2xCol.3 ÷100	5	6=Col.5x1.25	7=Col6x1.983	8	9
FEEDING/ LOADING DRYER	3	33.33%	1	25%	1.25	1.497	2	
RECIEVING/ UNLOADING FROM DRYER & FILLING BOXES (STAMPING)	9	16.67%	1.5	25%	1.875	2.246	3	
PACKAGING	10	10%	1	25%	1.25	1.497	2	
MAKING & DELEVERY OF EMPTY CARTOONS	2	45.45%	0.909	25%	1.136	1.36	2	
SUPERVISOR							1	

CALCULATION OF MANPOWER REQUIREMENT
PLANT P1/P2 FOR BLUE BAR SOAP PRODUCTION(TECHNICAL STAFF)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT.	REMARKS
1	2	3	4=Col.2xCol.3÷100	5	6=Col.5x1.25	7=Col.6x1.983	8	9
CRUTCHER & FEED TANK (TECH.STAFF)	4	16%	0.64	25%	0.8	0.958	1	

CALCULATION OF MANPOWER REQUIREMENT
PLANT P4, FOR 570 WASHING SOAP PRODUCTION
(WORKERS)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT	REMARKS
1	2	3	4=(Col.2xCol.3÷100	5	6=Col.4x1.25	7=Col.6 XI.1983	8	9
FEEDING/ LOADING DRYER	3	33.33%	1	25%	1.25	1.4979	2	
RECEIVING/ UNLOADING FROM DRYER	4	50%	2	25%	2.5	3	3	
FILLING BOXES /PETTY.	8	28.48%	2.278	25%	2.8485	3.41	4	
PULLING WIRE NAILING/TYING /MARKING BOXES.	14	23.68%	3.315	25%	4.14	4.96	5	Observation was for Petty. One half is recommended for Cartoon.
WASTE COLLECTION & CLEANING & RECYCLING.	1	95%	0.95	25%	1.1875	1.42	2+1 (for all plant)	For convenience of work execution 1 worker for each plant is recommended.
SUPERVISOR							1	

CALCULATION OF MANPOWER REQUIREMENT
PLANT P4,570 WASHING SOAP PRODUCTION(TECHNICAL STAFF)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT.	REMARKS
1	2	3	4=Col.2xCol.3÷100	5	6=Col.4x1.25	7=Col.6x1.1983	8	9
CRUTCHER, FEED TANK, CUTTER.	4	18.85%	0.75	25%	0.94	1.13	2	
STAMPING	2	34.43%	0.688	25%	0.86	1.03	1	
FORMAN							1	One Foreman for whole Washing Soap line is recommended.

CALCULATION OF MANPOWER REQUIREMENT
TOILET SOAP PRODUCTION PLANT. P3
(Technical & Operational)

WORK STATION	NO.OF WORKERS/ OPERATORS ALLOCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WORKERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS per shift.	REMARKS
1	2	3	4	5	6	7	8	9
CHUTCHER FEED TANK & CUTTING (Tech.Staff)	6	36%	2.16	25%	2.7	3.23	4	Technical Staff.
RECEIVING & STAMPING.	4 +2(OP)	43%	2.58	25%	3.225	3.85	4	3 Operational worker. 1 Technical Operator.
WRAPPING	8 + 2(OP)	36%	3.6	25%	4.5	5.37	6	5 Operational Worker. 1 Technical Operator.
FULLING	4	16%	0.64	25%	0.8	0.96	1+1	
TAPING	4	22%	0.88	25%	1.1	1.32	2	
CARTOON PREPARATION	3	20%	0.8	25%	1	1.1983	2	
CAPTOON SUPPLI	1 =4							
SUPERVISOR							1	One Foreman for whole Toilet Soap Line is recomended.
FOREMAN							1	

CALCULATION OF MANPOWER REQUIREMENT
COMMON FOR ALL PLANTS OF SOAP PROCESSING.

WORK STATION	NO.OF WORKERS/ OPERATORS ALLCCATED	% WORKING(As Obtained from Activity Sampling Data)	NO.OF WORKERS/ REQUIRED TO PERFORM WORK CONTENT.	ALLOWABLE RELAXATION ALLOWENCES	NO.OF WORKERS REQUIRED CONSIDERING R.ALLOWENCES.	NO.OF WOREERS REQUIRED CONSIDERING LEAVE & ABSENTEEISM.	RECOMMENDED NO.OF WORKERS PER SHIFT	REMARKS
1	2	3	4=Col2xCol3÷100	5	6=Col5x1.25	7=Col6x1.983	8	9
DUNNAGE & TRANSPORTATION		21.6%	0.86	25%	1.08	1.29	3	For convenience of operation 2 worker are recomended for each plant
COLOUR PERFUME	-	-	-	-	-	-	2	
OTHER UTILITY SERVICES	-	-	-	-	-	-	2	

W: Present & Working
NW: Present & not Working i.e. idle
A: Not present at work station.

ACTIVITY SAMPLING DATA SHEET - 1
SNOW (IN TUBE) SECTION - FILLING & PACKING PART (PRODUCTION STAFF)

Date: 10.9.1991.

ROUND	FILLING & BELT CLEANING (4)			PACKET READY AND STAMPING (2)			INSERTING TUBE (2)			PACKET CLOSE AND ARRANGE (4)			MAKING ONE DOZ. PACKET (2)			FINAL PACKING (2)			HOPPER, TUBE FORMING, CARTOON PREPARATION AND WASTE COLLECTION (3)			REMARKS
	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
09.20	1	1	2	2	-	-	1	-	1	-	3	1	-	2	-	-	-	2	-	1	2	
09.25	1	1	2	2	-	-	1	-	1	-	3	1	-	1	1	-	-	2	1	-	2	
09.30	1	1	2	2	-	-	1	-	1	-	3	1	-	1	1	-	2	-	-	1	2	
09.35	1	1	2	1	1	-	1	-	1	1	2	1	1	1	-	-	2	-	1	-	2	
09.40	1	1	2	1	1	-	1	-	1	1	2	1	1	1	-	1	-	1	1	-	2	
09.45	1	1	2	1	-	1	1	-	1	1	2	1	1	1	-	1	-	1	-	-	3	
09.50	1	1	2	1	-	1	1	-	1	2	1	1	1	-	1	1	-	1	-	-	3	
09.55	1	1	2	1	-	1	1	-	1	2	1	1	1	-	1	1	-	1	-	-	3	
10.00	1	1	2	1	-	1	1	-	1	2	1	1	1	-	1	-	-	2	1	-	2	
10.05	1	1	2	2	-	-	1	-	1	2	1	1	1	-	1	-	-	2	1	-	2	
10.10	1	1	2	2	-	-	1	-	1	2	1	1	1	-	1	-	-	2	1	1	1	
10.15	1	-	3	2	-	-	1	-	1	3	-	1	2	-	-	-	-	2	1	1	1	
10.20	1	-	3	2	-	-	1	-	1	3	-	1	2	-	-	1	-	1	-	1	2	
10.25	1	-	3	2	-	-	1	-	1	3	-	1	1	-	1	1	-	1	-	1	2	
10.30	1	-	3	2	-	-	1	-	1	3	-	1	1	-	1	1	-	1	1	2	-	
10.35	1	-	3	1	-	1	1	-	1	3	-	1	1	-	1	1	-	1	-	2	1	
10.40	1	-	3	1	-	1	1	-	1	3	-	1	1	-	1	1	-	1	-	-	3	
10.45	1	-	3	1	-	1	1	-	1	3	-	1	1	-	1	-	-	2	-	-	3	
10.50	1	-	3	1	-	1	1	-	1	3	-	1	1	-	1	-	-	2	-	-	3	
10.55	1	-	3	1	-	1	1	-	1	1	1	2	2	-	-	1	-	1	-	-	3	
11.00	1	-	3	1	-	1	1	-	1	1	1	2	2	-	-	1	-	1	-	-	3	

Contd. Page 2 of 19.

ACTIVITY SAMPLING DATA SHEET - II
SNOW (IN TUBE) SECTION-FILLING &
PACKING PART (PRODUCTION STAFF)

Date: 10.9.1991.

ROUND	FILLING & BELT CLEANING (4)			PACKET READY AND STAMPING (2)			INSERTING TUBE (2)			PACKET CLOSE AND ARRANGE (4)			MAKING ONE DOZ. PACKET (2)			FINAL PACKING (2)			HOPPER, TUBE FORMING, CARTOON PREPARATION AND WASTE COLLECTION (3)			REMARKS
	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
11.05	1	-	3	1	-	1	1	-	1	2	-	2	1	-	1	1	-	1	-	-	3	
11.10	1	-	3	1	-	1	1	-	1	2	-	2	1	-	1	-	1	1	-	-	3	
11.15	1	-	3	1	-	1	1	-	1	2	-	2	1	-	1	-	1	1	1	-	2	
11.20	1	-	3	2	-	-	1	-	1	2	-	2	1	-	1	-	1	1	1	-	2	
11.25	-	-	4	-	-	2	-	-	2	-	2	2	1	-	1	1	-	1	1	-	2	
11.30	-	-	4	-	-	2	-	-	2	-	2	2	1	-	1	1	-	1	1	-	2	
11.35	1	-	3	-	-	2	-	1	1	-	3	1	-	-	2	1	-	1	1	-	2	
11.40	1	-	3	-	-	2	-	1	1	1	2	1	-	-	2	1	-	1	1	-	2	
11.45	1	-	3	-	-	2	1	-	1	3	-	1	-	-	2	1	-	1	1	-	2	
11.50	2	-	2	1	-	1	1	-	1	3	-	1	2	-	-	-	-	2	1	-	2	
11.55	1	1	2	1	-	1	1	-	1	3	-	1	2	-	-	-	-	2	1	-	2	
12.00	1	1	2	1	-	1	1	-	1	3	-	1	-	-	2	-	-	2	1	-	2	
12.05	1	-	3	1	-	1	1	-	1	2	1	1	1	-	1	1	-	1	1	-	2	
12.10	1	-	3	1	-	1	1	-	1	2	1	1	1	-	1	1	-	1	-	-	3	
12.15	1	-	3	1	-	1	1	-	1	2	1	1	1	-	1	1	-	1	-	-	3	
12.20	1	-	3	1	-	1	1	-	1	2	-	2	1	-	1	1	-	1	1	1	1	
12.25	1	-	3	1	-	1	1	-	1	2	-	2	1	-	1	1	-	1	1	1	1	
12.30	1	-	3	-	-	2	1	-	1	3	-	1	1	-	1	-	-	2	1	1	1	
12.35	1	-	3	-	-	2	1	-	1	3	-	1	2	-	-	-	-	2	1	-	2	
12.40	1	-	3	-	-	2	1	-	1	3	-	1	2	-	-	-	-	2	1	-	2	
TOTAL	40	13	111	43	2	37	37	2	43	79	34	51	42	9	31	24	6	28	24	12	87	
%	24.3%			52.44%			45.1%			48.1%			51.2%			29.26%			19.51%			

ACTIVITY SAMPLING DATA SHEET - I

SNOW(IN BOTTLE) SECTION - FILLING & PACKING PART (PRODUCTION STAFF)

Date: 17.9.1991.

ROUND	FILLING AND CAP PLACING (6)			HOPPER & CLEANING BOTTLE (3)			PACKET OPEN & STAMPING, MAKE STRAIGHT, CARTOON READY, WASTE COLLECTION (5)			CAP PUTTING ON BOTTLE (4)			LEVEL WRAPPING ARROUND THE BOTTLE (8)			SINGLE PACKET MAKING (8)			PACKING OF ONE DOZ. AND SIX DOZ. AND PLACING (6)			REMARKS
	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
08.30	2	2	2	2	-	1	2	1	2	1	2	1	2	2	4	2	2	4	2	-	4	
08.35	2	2	2	1	1	1	2	1	2	1	2	1	2	2	4	2	2	4	2	-	4	
08.40	3	2	1	1	1	1	2	1	2	1	1	2	4	2	2	4	-	4	3	1	2	
08.45	3	-	3	1	1	1	2	1	2	2	-	2	4	-	4	4	-	4	3	1	2	
08.50	3	-	3	1	-	2	2	1	2	2	-	2	4	-	4	4	-	4	3	1	2	
08.55	3	-	3	-	1	2	2	1	2	2	-	2	4	-	4	3	2	3	2	-	4	
09.00	3	-	3	-	1	2	2	1	2	2	-	2	4	-	4	3	2	3	2	-	4	
09.05	3	-	3	-	1	2	2	-	3	2	-	2	2	-	6	3	2	3	2	-	4	
09.10	3	-	3	1	-	2	2	-	3	2	-	2	2	-	6	2	-	6	2	-	4	
09.15	3	-	3	1	-	2	2	1	2	2	-	2	4	2	2	2	-	6	2	-	4	
09.20	3	-	3	1	-	2	2	-	3	2	2	-	4	2	2	2	-	6	2	-	4	
09.25	3	-	3	1	-	2	2	1	2	2	2	-	4	2	2	2	-	6	2	-	4	
09.30	3	-	3	1	-	2	2	1	2	1	1	2	2	2	4	4	-	4	2	-	4	
09.35	3	-	3	1	1	1	2	1	2	1	1	2	2	2	4	4	-	4	3	1	4	
09.40	3	-	3	1	2	-	2	1	2	2	-	2	2	2	4	4	-	4	3	1	4	
09.45	2	1	3	1	1	1	2	-	3	2	-	2	2	2	4	4	-	4	3	1	2	
09.50	2	1	3	1	2	-	2	3	-	2	-	2	4	-	4	2	2	4	3	1	2	
09.55	2	1	3	1	-	2	2	-	3	2	-	2	4	-	4	2	2	4	3	1	2	
10.00	2	2	2	-	1	2	2	-	3	2	-	2	4	-	4	2	2	4	2	-	4	
10.05	2	1	3	-	-	3	2	-	3	2	-	2	4	-	4	4	-	4	2	-	4	
10.10	2	1	3	-	-	3	1	2	2	2	-	2	4	-	4	4	-	4	2	-	4	

Contd. Data Sheet - 2.

ACTIVITY SAMPLING DATA SHEET - II

SNOW(IN BOTTLE) SECTION - FILLING & PACKING PART (PRODUCTION STAFF)

Date: 17.9.1991.

ROUND	FILLING AND CAP PLACING (6)			HOPPER & CLEANING BOTTLE (3)			PACKET OPEN & STAMPING, MAKE STRAIGHT, CARTOON READY, WASTE COLLECTION (5)			CAP PUTTING ON BOTTLE (4)			LEVEL WRAPPING ARROUND THE BOTTLE (8)			SINGLE PACKET MAKING (8)			PACKING OF ONE DOZ. AND SIX DOZ. AND PLACING (6)			REMARKS
	W	NW	A	W	NW	A	WW	NW	AA	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
10.15	2	1	3	1	-	2	1	1	3	2	-	2	4	-	4	4	-	4	2	-	4	
10.20	2	-	4	1	-	2	1	1	3	2	-	2	4	-	4	4	-	4	2	-	4	
10.25	2	-	4	1	-	2	1	1	3	2	-	2	2	2	4	3	1	4	2	-	4	
10.30	2	-	4	1	-	2	1	1	3	2	-	2	2	2	4	3	1	4	2	-	4	
10.35	2	-	4	1	-	2	1	1	3	2	-	2	3	1	4	3	1	4	2	-	4	
10.40	2	-	4	-	-	3	2	-	3	2	-	2	3	1	4	4	-	4	2	-	4	
10.45	2	-	4	-	-	3	2	-	3	2	-	2	3	1	4	4	-	4	2	-	4	
10.50	2	-	4	-	-	3	2	-	3	2	-	2	3	1	4	2	2	4	2	-	4	
10.55	2	-	4	-	-	3	2	-	3	2	-	2	3	1	4	2	-	6	2	-	4	
11.00	2	-	4	-	-	3	2	-	3	2	-	2	3	1	4	2	-	6	2	-	4	
11.05	2	-	4	-	-	3	2	-	3	2	-	2	3	1	4	2	-	6	2	-	4	
11.10	2	-	4	-	-	3	2	1	2	2	-	2	3	1	4	2	-	6	2	-	4	
Total	75	14	97	20	12	49	59	14	76	59			98			92			70			
%	40.32%			21.5%			38.06%			47.58%			39.52%			37.1%			37.63%			

ACTIVITY SAMPLING DATA SHEET - I

POWDER PLANT - FILLING AND PACKING PART (PRODUCTION STAFF)

Date: 18.9.1991.

ROUND	FILLING, WEIGHING & INSPECTION (3)			CAP FITTING (2)			CLEANING CONTAINER, CARTOON READY, PETTY OPENING & STAMPING (3)			FINAL PACKING (3)			REMARKS
	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
09.20	1	-	2	1	1	-	2	-	1	1	1	1	
09.25	1	-	2	1	1	-	1	-	2	2	-	1	
09.30	1	1	1	1	1	-	2	-	1	2	-	1	
09.35	1	1	1	2	-	-	2	-	1	1	1	1	
09.40	1	1	1	2	-	-	1	1	1	1	1	1	
09.45	1	1	1	2	-	-	1	1	1	1	1	1	
09.50	1	-	2	2	-	-	1	-	2	1	1	1	
09.55	1	-	2	2	-	-	-	1	2	1	-	2	
10.00	1	-	2	2	-	-	1	-	2	1	-	2	
10.05	1	-	2	1	1	-	1	-	2	1	-	2	
10.10	1	-	2	2	-	-	2	-	1	1	-	2	
10.15	1	-	2	-	-	2	2	-	1	1	1	1	
10.20	1	-	2	-	-	2	1	-	2	-	1	2	
10.25	1	-	2	1	-	1	1	-	2	-	1	2	
10.30	1	-	2	1	-	1	2	-	1	1	1	1	
10.35	1	-	2	1	-	1	-	1	2	1	1	1	
10.40	1	1	1	1	-	1	1	-	2	1	1	1	
10.45	1	1	1	1	-	1	1	-	2	-	-	3	
10.50	1	1	1	1	-	1	1	-	2	-	-	3	
10.55	1	1	1	1	-	1	1	-	2	-	-	3	
11.00	1	1	1	1	-	1	1	-	2	2	-	1	

ACTIVITY SAMPLING DATA SHEET -II

POWDER PLANT - FILLING AND PACKING PART (PRODUCTION STAFF)

Date: 18.9.1991.

ROUND	FILLING, WEIGHING & INSPECTION (3)			CAP FITTING (2)			CLEANING, CONTAINER, CARTOON READY, PETTY OPENING & STAMPING (3)			FINAL PACKING (3)			REMARKS
	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
11.05	1	1	1	1	1	-	1	-	2	2	-	1	
11.10	1	1	1	1	1	-	1	-	2	1	1	1	
11.15	1	-	2	1	1	-	1	-	2	1	1	1	
11.20	1	-	2	1	-	1	2	1	-	1	-	2	
11.25	1	-	2	1	-	1	2	-	1	1	-	2	
11.30	-	1	2	-	1	1	-	1	2	-	1	2	
11.35	-	1	2	-	1	1	-	1	2	-	1	2	
Total	25	10	40	30	7	13	31	7	45	32	15	44	
%	33.33%			60.00%			41.33%			42.66%			

ACTIVITY SAMPLING DATA SHEET - I

TECHNICAL STAFF OF SNOW(TUBE), SNOW (BOTTLE) AND POWDER PLANT

Date: 19.9.1991. Date: 21.9.1991. Date: 22.9.1991.

ROUND	SNOW (TUBE), TOOTH PASTE, SHEAVING CREAM PLANT (4)			ROUND	SNOW(IN BOTTLE) PLANT (4)			ROUND	POWDER PLANT (4)			REMARKS
	W	NW	A		W	NW	A		W	NW	A	
10.15	1	-	3	09.20	1	-	3	08.50	1	-	3	
10.20	1	-	3	09.25	1	-	3	08.53	1	-	3	
10.25	1	-	3	09.30	1	-	3	08.56	1	-	3	
10.30	1	-	3	09.35	2	-	2	09.00	1	-	3	
10.35	1	-	3	09.40	2	-	2	09.03	1	-	3	
10.40	2	-	2	09.45	1	-	3	09.06	2	-	2	
10.45	2	-	2	09.50	1	-	3	09.10	1	1	2	
10.50	1	-	3	09.55	-	1	3	09.15	1	1	2	
10.55	-	1	3	10.00	-	1	3	09.20	1	1	2	
11.00	-	1	3	10.05	-	1	3	09.25	-	2	2	
11.05	-	1	3	10.10	1	-	3	09.30	-	2	2	
11.10	-	1	3	10.15	1	-	3	09.35	1	1	2	
11.15	-	1	3	10.20	1	-	3	09.40	1	1	2	
11.20	-	1	3	10.25	1	-	3	09.45	1	1	2	
11.25	-	-	4	10.30	1	-	3	09.50	1	-	3	
11.30	-	-	4	10.35	-	1	3	09.55	1	-	3	
11.35	1	-	3	10.40	1	-	3	10.00	1	-	3	
11.40	-	-	4	10.45	1	-	3	10.03	1	-	3	
11.45	-	1	3	10.50	-	1	3	10.06	1	-	3	
11.50	-	-	4	10.55	1	-	3	10.09	1	-	3	
11.55	-	1	3	11.00	1	1	2	10.12	1	-	3	
12.00	-	-	4	11.05	-	1	3	10.15	2	-	2	
12.05	1	-	3	11.10	-	1	3	10.18	2	-	2	

Contd Sheet ...

ACTIVITY SAMPLING DATA SHEET - II

TECHNICAL STAFF OF SNOW(TUBE), SNOW (BOTTLE) AND POWDER PLANT

Date: 19.9.1991. Date:21.9.1991. Date: 22.9.1991.

ROUND	SNOW (TUBE), TOOTH PASTE, SHEAVING CREAM PLANT (4)			ROUND	SNOW(IN BOTTLE), PLANT (4)			ROUND	POWDER PLANT (4)			REMARKS
	W	NW	A		W	NW	A		W	NW	A	
12.10	2	-	2	11.15	-	1	3	10.22	2	-	2	
12.15	1	-	3	11.20	-	-	4	10.25	1	1	2	
12.20	-	1	3	11.25	-	-	4	10.28	1	-	3	
12.25	-	-	4	11.30	1	1	2	10.32	1	-	3	
12.30	1	-	3	11.35	2	-	2	10.35	1	-	3	
12.35	-	-	4	11.40	2	-	2	10.38	1	-	3	
12.40	-	-	4	11.45	-	-	4	10.42	2	-	2	
12.45	1	-	3	11.50	-	-	4	10.45	2	-	2	
12.50	2	-	2	11.55	1	-	3	10.48	1	-	3	
12.55	-	-	4	12.00	2	-	2	10.52	-	1	3	
13.00	1	-	3	12.05	2	-	2	10.55	-	1	3	
13.05	1	-	3	12.10	1	-	3	10.58	1	-	3	
13.10	1	-	3	12.15	1	-	3	11.02	1	-	3	
13.15	1	-	3	12.20	-	1	3	11.05	1	1	2	
13.20	1	-	3	12.25	-	1	3	11.08	-	1	3	
13.25	2	-	2	12.30	-	1	3	11.12	-	1	3	
13.30	-	1	3	12.35	1	-	3	11.15	-	1	3	
13.35	-	1	3	12.40	1	-	3	11.18	-	1	3	
Total	26	11	127		32	13	119		39	17	108	
%	15.85%	6.7%	77.44%		19.51%	7.93%	72.56%		23.78%	10.37%	65.85%	

ACTIVITY SAMPLING DATA SHEET

TRANSPORTATION & WASTE CARTOON DISPOSAL OF PLANT
SNOW (IN TUBE), SNOW (IN BOTTLE) AND POWDER

Date: 23.9.1991. Date: 24.9.1991. Date: 25.9.1991.

ROUND	TRANSPORTATION AND CARTOON DISPOSAL (4)			ROUND	TRANSPORTATION AND CARTOON DISPOSAL (4)			ROUND	TRANSPORTATION AND CARTOON DISPOSAL (4)			REMARKS
	W	NW	A		W	NW	A		W	NW	A	
09.32	-	-	4	11.00	2	-	2	10.10	2	2	-	
09.35	-	-	4	11.03	2	-	2	10.13	-	-	4	
09.38	3	-	1	11.06	2	-	2	10.16	-	-	4	
09.42	-	-	4	11.09	-	-	4	10.19	-	-	4	
09.45	-	-	4	11.12	-	4	-	10.22	2	2	-	
09.48	-	-	4	11.15	-	-	4	10.25	-	-	4	
09.51	-	-	4	11.18	-	-	4	10.28	-	-	4	
09.55	3	-	1	11.21	3	-	1	10.31	2	-	2	
09.58	-	-	4	11.24	-	-	4	10.34	-	-	4	
10.02	-	-	4	11.27	-	-	4	10.37	-	-	4	
10.05	-	-	4	11.30	3	-	1	10.40	-	-	4	
10.08	-	-	4	11.33	-	-	4	10.43	2	-	2	
10.12	2	-	2	11.36	-	-	4	10.46	-	-	4	
10.15	-	-	4	11.39	2	-	2	10.49	-	-	4	
10.18	-	-	4	11.42	-	4	-	10.52	2	-	2	
10.21	2	-	2	11.45	-	4	-	10.55	3	-	1	
10.24	-	-	4	11.48	2	-	2	10.58	-	-	4	
10.27	-	-	4	11.51	-	-	4	11.00	-	-	4	
10.30	2	-	2	11.54	-	-	4	11.03	-	-	4	
10.33	-	-	4	11.57	-	-	4	11.06	3	-	1	
10.36	-	-	4	12.00	3	-	1	11.09	3	-	1	
10.40	2	-	2	12.03	2	-	2	11.12	3	-	1	
Total	14	-	74	Total	21	24	43	Total	22	4	62	
								G.Total	57	28	179	
								%	21.59%	10.60%	67.8%	

W: Present & Working
NW : Present & not Working i.e.idle
A: Not present at work station.

ACTIVITY SAMPLING DATA SHEET-1
P1/P2,PLANT BLUE BAR SOAP.

DATE: 06.8.1991.

ROUND	CRUTCHER,FEED TANK,CUTTER. (Tech.Staff)(4)			FEEDING/ LOADING DRYER (2)			FILLING BOXES/ UNLOADING DRYER (9)			PACKAGING (10)			MAKING & DELE-VERY OF EMPTY CARTOONS(2)			REMARKS		
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A			
1100	1	-	3	1	-	1	1	-	8	1	1	8	1	-	1			
1103	1	-	3	1	-	1	2	-	7	-	3	7	1	-	1			
1105	1	-	3	1	-	1	2	-	7	1	1	8	1	-	1			
1108	1	-	3	1	-	1	1	-	8	1	1	8	1	-	1			
1111	1	-	3	1	-	1	1	-	8	1	2	7	1	-	1			
1115	2	-	2	1	-	1	1	-	8	1	2	7	1	-	1			
1118	-	-	4	1	-	1	1	-	8	1	1	8	1	-	1			
1121	2	-	2	1	-	1	1	-	8	1	1	8	1	-	1			
1125	1	-	3	1	-	1	-	-	9	1	1	8	1	-	1			
1130	-	1	3	1	-	1	1	-	8	1	-	9	1	-	1			
1133	-	1	3	1	-	1	1	-	8	1	-	9	1	-	1			
1137	-	1	3	1	-	1	2	-	7	1	-	9	1	-	1			
1141	-	1	3	1	-	1	2	-	7	1	-	9	1	-	1			
1145	-	1	3	1	-	1	1	-	8	1	-	9	1	-	1			
1148	-	1	3	1	-	1	2	-	7	1	-	9	1	-	1			
1152	-	-	4	1	-	1	2	-	7	1	-	9	1	-	1			
1156	-	-	4	1	-	1	2	-	7	1	-	9	1	-	1			
1200	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1			
1206	-	-	4	1	-	1	2	-	7	1	-	9	1	-	1			
1209	-	1	3	1	-	1	2	-	7	1	-	9	-	-	2			
1212	-	-	4	1	-	1	2	-	7	1	-	9	-	-	2			
1215	1	-	3	1	-	1	2	-	7	1	-	9	-	-	2			
TOTAL	12	7	69	22	-	22	33	-	165	21	13	186	19	-	25			

NB: WASTE COLLECTION INCLUDED IN P4 STUDY SHEET.

Contd. Sheet- 2.

W:Present & working
NW:Present & not working i.e.idle
A:Not present in plant & not working.

ACTIVITY SAMPLING DATA SHEET- 2
P1/P2,PLANT BLUE BAR SOAP.

DATE: 07.8.1991.

ROUND	CRUTCHER & FEED TANK(Tech.(2)			FEEDING/ LOADING DRYER (2)			FILLING BOXES FROM DRYER (9)			PACKAGING (10)			MAKING & DEVE-VERY OF EMPTY CARTOONS (2)			REMARKS		
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A			
1050	2	-	2	1	-	1	1	1	7	1	1	8	1	-	-			
1055	1	-	3	1	-	1	-	-	9	-	3	7	1	-	-			
1100	-	1	3	1	-	1	2	-	7	1	1	8	-	-	2			
1105	-	-	4	1	-	1	2	-	7	1	1	8	-	-	2			
1108	1	-	3	1	-	1	1	-	8	1	2	7	-	-	2			
1111	-	-	4	1	-	1	1	-	8	1	2	7	-	-	2			
1114	-	-	4	1	-	1	1	-	8	1	1	8	-	-	2			
1117	1	-	3	1	-	1	1	-	8	1	1	8	1	-	1			
1120	2	-	2	1	-	1	1	-	8	1	1	8	1	-	1			
1123	-	-	4	1	-	1	2	-	7	1	-	9	1	-	1			
1126	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1			
1129	1	-	3	1	-	1	1	-	8	2	-	8	1	-	1			
1132	1	-	3	1	-	1	1	-	8	1	-	9	1	-	1			
1135	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1			
1138	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1			
1141	2	-	2	1	-	1	2	-	7	1	-	9	1	-	1			
1144	-	1	3	1	-	1	2	-	7	1	-	9	1	-	1			
1147	-	1	3	1	-	1	2	-	7	1	-	9	1	-	1			
1150	-	1	3	1	-	1	1	-	8	1	-	9	1	-	1			
1153	-	1	3	1	-	1	2	-	7	1	-	9	1	-	1			
1157	-	1	3	1	-	1	2	-	7	1	-	9	1	-	2			
1200	-	1	3	1	-	1	2	-	7	1	-	9	1	-	2			
TOTAL	14	7	67	22	-	22	33	1	164	22	13	185	20	-	24			

Contd. Sheet-3.

W : Present & Working
NW: Present & not working
A : Not present in Plant & not working.

ACTIVITY SAMPLING DATA SHEET-3
P1/P2,PLANT,BLUE BAR SOAP.

DATE: 8.8.1991.

ROUND	CRUTCHER & FEED TANK(Tech)(2)			FEEDING/ LOADING DRYER (2)			FILLING BOXES/ UNLOADING FROM DRYER(STAMP)(9)			PACKAGING (10)			MAKING & DELEVERY OF EMPTY CARTOONS (2)			REMARKS
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
1040	-	1	3	1	-	1	2	-	7	1	-	9	-	-	2	
1043	-	1	3	1	-	1	2	-	7	1	-	9	-	-	2	
1046	-	1	3	1	-	1	1	-	8	1	-	9	-	-	2	
1049	-	1	3	1	-	1	1	-	8	1	-	9	-	-	2	
1055	-	1	3	1	-	1	1	-	8	1	-	9	-	-	2	
1058	-	1	3	1	-	1	1	-	8	1	-	9	1	-	1	
1102	2	-	2	1	-	1	1	-	8	1	-	9	1	-	1	
1106	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1	
1111	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1	
1115	1	-	3	1	-	1	1	-	8	1	-	9	1	-	1	
1118	1	-	3	1	-	1	1	-	8	2	-	8	1	-	1	
1122	1	-	3	1	-	1	2	-	7	1	-	9	1	-	1	
1125	-	-	4	1	-	1	2	-	7	1	-	9	1	-	1	
1128	2	-	2	1	-	1	2	-	7	1	1	8	1	-	1	
1131	1	-	3	1	-	1	2	-	7	1	1	8	1	-	1	
1135	-	-	4	1	-	1	2	-	7	1	1	8	1	-	1	
1139	-	-	4	1	-	1	1	-	8	1	2	7	1	-	1	
1145	1	-	3	1	-	1	2	-	7	1	2	7	2	-	-	
1148	-	-	4	1	-	1	2	-	7	2	1	7	1	-	1	
1151	-	1	3	1	-	1	2	-	7	1	1	8	2	-	-	
1154	3	-	1	1	-	1	1	2	6	-	3	7	2	-	-	
1157	2	-	2	1	-	1	-	-	9	1	1	8	2	-	-	
TOTAL	16	7	65	22	-	22	33	2	163	23	13	184	21	-	23	
G.Tot.	42	21	201	66	-	66	99	3	492	66	39	555	60	-	72	
%	18%	8%	76%	50%	-	50%	16.67%			10%	5.9%	84.1%	45.45%	-	54.55%	

0.5% 32.83%

TOILET

ACTIVITY SAMPLING DATE SHEET-1. DATE:13.8.1991.
PLANT P3: TOILET SOAP PRODUCTION.

TIME	CRUTCHER & FEED TANK & CUTTING.			RECEIVING & STAMPING			WRAPPING			PULLING			TAPING			CARTOON PREPARATION & SUPPLY.			TRANK & DUNNAGE		
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A
9-30	2	-	4	3	-	3	5	1	4	2	-	2	1	1	2	1	-	3	2	-	2
9-50	2	-	4	3	-	3	5	1	4	-	-	4	1	1	2	1	-	3	-	-	4
1031	1	2	3	3	-	3	4	3	3	-	-	4	-	-	4	-	-	4	-	-	4
1046	3	1	2	3	1	2	5	1	4	-	-	4	1	-	3	1	-	3	-	-	4
1100	2	1	3	3	-	3	5	1	4	1	1	2	1	-	3	1	-	3	-	-	4
1110	3	1	3	3	-	3	5	1	4	1	1	2	1	1	2	1	-	3	2	-	2
1122	2	2	2	3	1	2	4	1	5	-	1	3	1	1	2	1	-	3	2	-	2
1135	3	-	3	3	1	2	5	-	5	1	-	2	1	1	2	-	1	3	-	-	4
1139	3	-	3	3	1	2	5	1	4	1	-	2	1	-	3	-	1	3	-	-	4
1203	1	2	3	3	-	3	4	1	5	-	2	2	1	-	3	1	-	3	-	-	4
1217	1	2	3	3	-	3	4	1	5	1	1	2	1	-	3	1	-	3	-	-	4
1230	2	2	2	3	-	3	4	2	4	1	-	3	1	-	3	-	1	3	-	-	4
1237	3	-	3	2	2	2	5	2	3	-	1	4	1	1	2	-	1	3	2	-	2
1245	2	-	4	2	2	2	4	1	5	1	1	3	1	1	2	1	1	3	-	-	2
1250	2	-	4	2	1	3	4	2	4	-	1	4	1	1	2	1	-	3	-	-	2
Total	32			42			68			9			14			14			8		

Contd. Sheet-2.

ACTIVITY SAMPLING DATA SHEET-2
PLANT P3: TOILET SOAP PRODUCTION

DATE: 14.8 .1991.

TOILET

TIME	CRUCHER, FEED TANK, CUTTING			RECEIVING & STAMPING			WRAPPING			PULLING			TAPING			CARTOON PREPARATION & SUPPLY.			TRANK & DUNNAGE		
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A
1041	1	1	4	3	-	3	5	2	3	1	1	2	1	-	3	1	-	2	2	-	2
1111	2	1	3	3	-	3	5	1	4	1	-	3	1	1	2	1	-	2	-	-	4
1115	3	-	3	3	-	3	4	2	4	1	-	3	1	1	2	1	-	2	-	-	4
1122	2	1	3	2	1	3	5	2	3	1	1	2	1	-	3	-	1	2	2	-	2
1130	2	1	3	2	1	3	5	1	4	1	1	2	1	-	3	-	1	2	2	-	2
1136	1	2	3	3	1	2	5	1	4	1	-	3	1	1	2	-	1	2	-	-	2
1145	3	-	3	3	1	2	4	2	4	-	1	3	1	1	2	1	-	2	2	-	2
1156	2	-	4	3	-	3	4	2	4	-	1	3	1	1	2	1	-	2	-	-	4
1205	2	1	3	3	-	3	5	1	4	1	-	3	1	-	3	1	-	2	-	-	4
1212	2	1	3	3	-	3	5	1	4	1	-	3	1	-	3	1	-	2	-	-	4
1218	2	-	4	3	-	3	5	1	4	-	1	3	1	-	3	1	-	2	2	-	2
1225	2	1	3	2	1	3	4	1	5	1	-	3	1	-	3	-	1	2	-	-	4
1230	2	1	3	2	1	3	4	1	5	-	1	3	1	-	3	-	1	2	-	-	4
1235	3	-	3	3	-	3	5	2	3	1	-	3	1	-	3	1	-	2	-	-	4
1240	2	1	3	3	1	2	5	2	3	1	-	3	1	1	2	1	-	2	2	-	2
1245	2	1	3	3	-	3	5	1	4	1	1	2	1	1	2	-	-	3	2	-	2
1247	2	1	3	3	-	3	5	1	4	1	1	2	1	1	2	-	-	3	2	-	2
1253	2	-	4	2	-	4	3	1	6	1	1	2	1	-	3	-	-	3	-	-	4
1255	1	-	5	2	-	4	3	1	6	1	1	2	-	-	4	-	-	3	2	-	2
Total	38			51			86			15			18			10			18		

Contd. Sheet-3

ACTIVITY SAMPLING DATA SHEET-3
P3: TOILET SOAP PRODUCTION PLANT. DATE: 15. 8 .1991.

TOILET

TIME	CRUCHER, FEED TANK & CUTTING			RECEIVING FROM THE DRIER & STAMPING+2(OD)			WRAPPING			PULLING			TAPING			CARTOON PREPARATION SUPPLY			TRANK & DUNNAGE (4)		
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A
1040	2	-	4	-	2	4	-	2	8	-	2	2	-	2	2	-	1	3	-	-	4
1055	2	1	3	1	1	4	-	3	7	-	1	3	-	1	3	-	1	3	-	-	4
1105	2	1	3	3	-	3	5	1	4	1	1	2	1	1	2	1	-	3	-	-	4
1111	3	1	2	3	1	2	5	1	4	1	1	2	1	1	2	1	-	3	2	-	2
1117	2	-	2	3	1	2	5	1	4	1	-	3	1	1	2	1	-	3	-	-	4
1125	2	1	2	3	1	2	5	1	4	-	1	3	1	-	3	-	-	4	2	-	2
1131	2	1	3	2	-	4	5	2	3	1	-	2	1	-	3	-	-	4	-	-	4
1139	3	-	3	3	-	3	5	1	4	-	-	3	1	-	3	-	-	4	-	-	4
1207	3	-	3	3	1	2	5	1	4	-	-	3	1	-	3	-	-	4	-	-	4
1213	2	1	3	2	-	4	5	2	3	1	-	3	1	-	3	-	-	4	2	-	2
1219	2	1	3	3	-	3	5	2	3	-	1	3	1	-	3	1	-	3	-	-	4
1225	3	-	3	3	1	2	5	1	4	-	1	3	1	-	3	1	-	3	-	-	4
1230	3	-	3	2	2	2	5	1	4	1	1	2	1	-	3	1	-	3	-	-	4
1235	2	1	3	2	2	2	5	2	3	1	-	3	1	-	3	1	-	3	2	-	2
1240	2	-	4	2	-	4	4	2	3	-	-	4	-	-	4	1	-	3	-	-	4
Total	35			33			64			7			12			8			8		
G.Total	105			126			218			31			44			32			34		
%	36%			43%			36%			16%			22%			20%			18%		

NB: WASTE COLLECTION INCLUDED IN P4 STUDY SHEET.

W: Present & Working
NW: Present but Not Working
A: Not Present at Work Station

ACTIVITY SAMPLING DATA SHEET-1
PLANT P4,570 WASHING SOAP PRODUCTION LINE DATE: 24 • 8 • 1991 •

ROUND	BRUTCHER & FEED TANK TV.CUTTER (Tech.Staff(4)			FEEDING & LOADING DRYER(4)			RECEIVING / UNLOADING FROM DRYER STAMP(4)			STAMPING M/C, ATTENDENT TECH.STAFF)(2)			FILLING BOXES/ UNLOADING FROM DRYER (8)			WIRE NAILING, TYING BOXES, PACKING ETC.(14)			WASTE COLLECTION & CLEANING.			REMARKS
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
0902	1	-	3	1	-	2	2	-	2	-	1	1	4	2	2	-	-	14	1	-	-	
0905	1	-	3	1	-	2	2	-	2	-	1	1	4	2	2	6	-	8	-	1	-	
0908	1	-	3	1	-	2	2	-	2	-	1	1	4	-	4	6	-	8	-	1	-	
0911	1	-	3	1	-	2	2	-	2	-	1	1	2	-	6	6	-	8	-	1	-	
0914	1	-	3	1	-	2	2	-	2	-	1	1	2	-	6	6	-	8	1	-	-	
0917	1	-	3	1	-	2	2	-	2	-	1	1	2	1	3	6	-	8	1	-	-	
0920	1	-	3	1	-	2	2	-	2	1	-	1	2	2	4	4	1	9	1	-	-	
0923	-	1	3	1	-	2	2	-	2	1	-	1	2	2	4	4	1	9	1	-	-	
0926	-	1	3	1	-	2	2	-	2	1	-	1	2	-	6	4	1	9	1	-	-	
0929	-	1	3	1	-	2	2	-	2	1	-	1	2	-	6	3	1	10	1	-	-	
0932	1	-	3	1	-	2	2	-	2	1	-	1	1	-	7	2	1	11	1	-	-	
0935	1	-	3	1	-	2	2	-	2	1	-	1	3	-	5	2	1	11	1	-	-	
0938	1	-	3	1	-	2	2	-	2	1	-	1	4	-	4	2	1	11	1	-	-	
0941	1	-	3	1	-	2	2	-	2	1	-	1	4	-	4	2	-	12	1	-	-	
0944	-	1	3	1	-	2	2	-	2	1	-	1	1	1	6	1	-	13	1	-	-	
0947	1	-	3	1	-	2	2	-	2	1	-	1	1	1	6	1	-	13	1	-	-	
0950	1	-	3	1	-	2	2	-	2	1	-	1	1	1	6	1	-	13	1	-	-	
0953	-	1	3	1	-	2	2	-	2	1	-	1	1	1	6	1	-	13	1	-	-	
0956	1	-	3	1	-	2	2	-	2	1	-	1	1	-	7	1	-	13	1	-	-	
0959	1	1	2	1	-	2	2	-	2	1	-	1	1	-	7	4	2	7	1	-	-	
TOTAL	15	6	59	20	-	40	40	-	40	14	6	20	44	13	103	62	9	208	17			

Contd. Sheet-2.

W; Present & Working
NW:Present but not Working
A: Not Present at Work Station.

ACTIVITY SAMPLING DATA SHEET-2
PLANT:P4;570 WASHING SOAP PRODUCTION LINE. DATE:.25.8.1991. .

ROUND	CRUTCHER & FEED TANK TV.CUTTER (Tech.Staff)(4)			FEEDING & LOADING DRYER (4)			RECEIVING /UN-LOADING FROM DRYER STAMP(4)			STAMPLING M/C ATTENDENT Tech.Staff)(2)			FELLING BOXES/WIRE NAILING, UNLOADING FROMTYING BOXES,PA-DRYER (8) CKING ETC.(14)						WASTE COLLEC-TION & CLEAN-ING.			REMARKS
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
1058	-	1	3	1	-	2	2	-	2	-	1	1	2	-	6	-	-	14	1	-	-	
1102	-	1	3	1	-	2	2	-	2	-	1	1	2	-	6	1	-	13	1	-	-	
1105	-	-	4	1	-	2	2	-	2	-	1	1	2	-	6	1	-	13	1	-	-	
1110	-	-	4	1	-	2	2	-	2	1	-	1	2	-	6	1	-	13	1	-	-	
1114	1	1	2	1	-	2	2	-	2	1	-	1	2	1	5	1	-	13	1	-	-	
1117	1	-	3	1	-	2	2	-	2	1	-	1	2	-	6	2	2	10	1	-	-	
1120	1	-	3	1	-	2	2	-	2	1	-	1	2	1	5	2	3	9	1	-	-	
1125	-	-	4	1	-	2	2	-	2	-	1	1	3	-	5	2	-	12	1	-	-	
1128	-	-	4	1	-	2	2	-	2	1	-	1	3	1	4	2	2	10	1	-	-	
1132	1	-	3	1	-	2	2	-	2	1	-	1	3	-	5	4	-	10	1	-	-	
1138	2	-	2	1	-	2	2	-	2	1	-	1	1	2	5	5	-	9	1	-	-	
1142	2	-	2	1	-	2	2	-	2	1	-	1	3	-	5	6	-	8	1	-	-	
1147	1	-	3	1	-	2	2	-	2	-	1	1	3	-	5	3	-	11	1	-	-	
1150	1	-	3	1	-	2	2	-	2	-	1	1	3	1	4	6	-	8	1	-	-	
1156	1	-	3	1	-	2	2	-	2	1	-	1	2	2	4	6	-	8	1	-	-	
1200	1	-	2	1	-	2	2	-	2	1	-	1	2	1	5	6	-	8	1	-	-	
1203	1	-	3	1	-	2	2	-	2	1	-	1	2	2	4	6	-	8	1	-	-	
1206	-	1	3	1	-	2	2	-	2	1	-	1	3	-	5	6	-	8	1	-	-	
1209	1	1	2	1	-	2	2	-	2	1	-	1	1	2	5	4	-	10	1	-	-	
1212	1	-	3	1	-	2	2	-	2	1	-	1	3	-	5	4	2	8	1	-	-	
1215	1	-	3	1	-	2	2	-	2	1	-	1	3	-	5	4	2	8	1	-	-	
1218	1	-	3	1	-	2	2	-	2	-	1	1	3	-	5	4	2	8	1	-	-	
TOTAL	17	5	66	22	-	44	44	-	44	15	7	22	52	13	111	76	13	219	22	-	-	

Contd. Sheet-3

W : Present & Working
NW: Present & not working i.e.idle
A : Not Present at Work station.

ACTIVITY SAMPLING DATA SHEET-3
570-WASHING SOAP PRODUCTION LINE.

DATE: 26.8.1991.

ROUND	CRUTCHER FEED TANK TV.CUTTER (TECH.STAFF)(4)			FEEDING & LOADING DRYER(4)			RECEIVING/UNLOADING FROM DRYER STAMP(4)			STAMPING M/C. ATTENDENT (TECH.STAFF)(2)			FILLING BOXES/ UNLOADING FROM DRYER(8)			WIRE NAILING, TYING BOXES, PACKING ETC.(14)			WASTE COLLECTION & CLEANING.			REMARKS
-	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	W	NW	A	
1100	1	1	2	1	-	2	2	-	2	1	-	1	1	2	5	-	-	8+6	1	-	-	
1103	-	1	3	1	-	2	2	-	2	1	-	1	3	-	5	1	-	7+6	1	-	-	
1108	1	-	3	1	-	2	2	-	2	1	-	1	2	2	4	1	-	7+6	1	-	-	
1114	1	-	3	1	-	2	2	-	2	1	-	1	2	1	5	1	-	7+6	1	-	-	
1117	1	-	3	1	-	2	2	-	2	1	-	1	2	2	4	1	-	7+6	1	-	-	
1120	1	-	3	1	-	2	2	-	2	1	-	1	3	1	4	2	2	4+6	1	-	-	
1123	1	-	3	1	-	2	2	-	2	-	1	1	3	-	5	2	3	3+6	1	-	-	
1126	2	-	2	1	-	2	2	-	2	-	1	1	3	-	5	2	-	6+6	1	-	-	
1129	2	-	2	1	-	2	2	-	2	-	1	1	1	2	5	2	2	4+6	1	-	-	
1132	1	-	3	1	-	2	2	-	2	1	-	1	3	-	5	4	-	4+6	1	-	-	
1138	-	-	4	1	-	2	2	-	2	1	-	1	3	1	4	5	-	3+6	1	-	-	
1141	-	-	4	1	-	2	2	-	2	1	-	1	3	-	5	6	-	2+6	1	-	-	
1144	1	-	3	1	-	2	2	-	2	-	1	1	2	1	5	3	-	5+6	1	-	-	
1147	1	-	3	1	-	2	2	-	2	1	-	1	2	-	6	6	-	2+6	1	-	-	
1150	1	1	2	1	-	2	2	-	2	1	-	1	2	1	5	6	-	2+6	1	-	-	
1153	-	-	4	1	-	2	2	-	2	-	1	1	2	-	6	6	-	2+6	1	-	-	
1158	-	-	4	1	-	2	2	-	2	-	1	1	2	-	6	6	-	2+6	1	-	-	
1202	-	1	3	1	-	2	2	-	2	1	-	1	2	-	6	4	-	4+6	1	-	-	
1215	-	1	3	1	-	2	2	-	2	1	-	1	2	-	6	6	-	2+6	1	-	-	
TOTAL	14	5	57	19	-	38	38	-	38	13	6	19	43	13	96	64	7	81+114	19	-	-	
G.TOTAL	46	16	182	61	-	122	122	-	122	42	19	61	139	39	310	202	29	622	58	3	-	
%	18.85%	6.56%	74.59%	33.33%	-	66.67%	50%	-	50%	34.42%	15.57%	50%	26.48%	6%	63.58%	25.08%	3.40%	72.92%	95%	5%		

NB: Cutter is cutting 2 bars in a row.
Observed Av. cutting speed: 244 pieces per min i.e. 120 pairs per min.

ACTIVITY SAMPLING DATA SHEET
DUNNAGE & TRANSPORTATION OF PLANT P1,P2,P3,P4.

DATE:27.8.1991. Date:28.8.1991 Date: 29.8.1991.

ROUND	DUNNAGE & TRANSPORTATION (4)			ROUND	DUNNAGE & TRANSPORTATION (4)			ROUND	DUNNAGE & TRANSPORTATION (4)			REMARKS
-	W	NW	A	-	W	NW	A	-	W	NW	A	
1042	-	-	4	1100	2	-	2	1119	2	2	-	
1045	-	-	4	1103	2	-	2	1121	-	-	4	
1050	3	-	1	1106	2	-	2	1125	-	-	4	
1054	-	-	4	1109	-	-	4	1128	-	-	4	
1057	-	-	4	1112	-	4	-	1131	2	2	-	
1100	-	-	4	1115	-	4	-	1135	-	-	4	
1103	-	-	4	1118	-	4	-	1138	-	-	4	
1106	3	-	1	1121	3	-	1	1141	2	-	2	
1109	-	-	4	1124	-	-	4	1143	-	-	4	
1112	-	-	4	1127	-	4	-	1145	-	-	4	
1115	-	-	4	1130	3	-	1	1148	-	-	4	
1118	-	-	4	1133	-	-	4	1151	2	-	2	
1121	2	-	2	1136	-	-	4	1155	-	-	4	
1124	-	-	4	1139	2	-	2	1200	-	-	4	
1127	-	-	4	1142	-	4	-	1203	2	-	2	
1130	2	-	2	1145	-	4	-	1206	3	-	1	
1133	-	-	4	1148	2	-	2	1209	3	-	1	
1136	-	-	4	1151	-	-	4	1212	-	-	4	
1139	2	-	2	1154	-	-	4	1215	-	-	4	
1142	-	-	4	1157	-	-	4	1218	-	-	4	
1145	-	-	4	1200	3	-	1	1221	3	-	1	
1148	2	-	2	1230	2	-	2	1225	3	-	1	
TOTAL	14	-	74	TOTAL	21	24	43	TOTAL	22	4	62	
								G.TOTAL	57	28	179	
								%	31.8%	10.6%	57.8%	

ACTIVITY SAMPLING DATA SHEET - I.

FILLING MACHINE OF SNOW (TUBE) SECTION

Date: June 18, 1991.

ROUND	Mr. Nur Islam, Operator			Mr. Shafi Ullah, Operator			Remarks
	W	NW	A	W	NW	A	
08.30	/	-	-	/	-	-	
08.40	/	-	-	/	-	-	
08.50	/	-	-	-	/	-	
09.00	/	-	-	-	/	-	
09.10	/	-	-	-	/	-	
09.20	-	/	-	-	-	/	
09.30	-	/	-	-	-	/	
09.40	/	-	-	-	-	/	
09.50	/	-	-	-	-	/	
10.00	/	-	-	-	-	/	
10.10	/	-	-	-	-	/	
10.20	/	-	-	-	/	-	
10.30	-	/	-	/	-	-	
10.40	/	-	-	-	/	-	
10.50	/	-	-	-	/	-	
11.00	/	-	-	-	/	-	
11.10	/	-	-	-	/	-	
11.20	/	-	-	-	-	/	
11.30	/	-	-	-	-	/	
11.40	-	/	-	-	-	/	
11.50	-	/	-	-	-	/	
12.00	/	-	-	-	-	/	
12.10	/	-	-	-	-	/	
12.20	/	-	-	-	-	/	
Total	19	5	-	3	8	13	

ACTIVITY SAMPLING DATA SHEET - II

FILLING MACHINE OF SNOW (TUBE) SECTION

Date: June 19, 1991.

ROUND	Mr. Nur Mohammad, Operator			Mr. Sabu Miah, Operator			Remarks
	W	NW	A	W	NW	A	
09.20	/	-	-	-	/	-	
09.30	/	-	-	-	/	-	
09.40	/	-	-	-	/	-	
09.50	/	-	-	-	/	-	
10.00	/	-	-	-	/	-	
10.10	/	-	-	-	/	-	
10.20	/	-	-	-	-	/	
10.30	/	-	-	-	-	/	
10.40	/	-	-	-	-	/	
10.50	/	-	-	-	-	/	
11.00	/	-	-	-	-	/	
11.10	/	-	-	-	-	/	
11.20	/	-	-	-	-	/	
11.30	-	-	/	-	-	/	
11.40	/	-	-	-	-	/	
11.50	/	-	-	/	-	-	
12.00	/	-	-	-	/	-	
12.10	/	-	-	-	-	/	
12.20	/	-	-	-	-	/	
12.30	/	-	-	-	-	/	
12.40	/	-	-	-	-	/	
12.50	/	-	-	-	-	/	
13.00	/	-	-	-	-	/	
Total	22	-	1	1	7	15	

ACTIVITY SAMPLING DATA SHEET - III

FILLING MACHINE OF SNOW (TUBE) SECTION

Date: June 20, 1991.

ROUND	Mr. Shafiullah, Operator			Mr. Minto Miah, Operator			Remarks
	W	NW	A	W	NW	A	
10.40	/	-	-	-	-	/	
10.50	/	-	-	-	-	/	
11.00	/	-	-	-	/	-	
11.10	/	-	-	-	/	-	
11.20	/	-	-	-	-	/	
11.30	/	-	-	-	/	-	
11.40	/	-	-	/	-	-	
11.50	/	-	-	-	/	-	
12.00	/	-	-	-	-	/	
12.10	/	-	-	-	/	-	
12.20	/	-	-	-	-	/	
12.30	/	-	-	-	-	/	
12.40	/	-	-	-	-	/	
12.50	/	-	-	-	-	/	
13.00	/	-	-	-	-	/	
13.10	/	-	-	-	-	/	
13.20	/	-	-	-	-	/	
Total	17	-	-	1	5	11	
G. Total	58	5	1	5	20	39	
%	90.6%	7.8%	1.56%	7.8%	31.25%	60.94%	

Total number of observation = 64

DETERMINATION OF MANPOWER BY TIME STUDY OF COSMETIC PROCESSING PLANT

To determine the manpower requirement by time study, output rate of plant Snow (in tube), Snow (in bottle) and Powder (single and double container filling machine) were fixed. First of all, recorded a complete decription of the method and then breaking down the operation into "elements" - i.e. various operation stages/work stations. Examined the detailed breakdown of the operation to ensure that the most effective method and motions were used.

In different operation stages/work stations line balancing method were followed in determination of manpower requirement which is reasonable with output rate.

Let us take production of plant Snow (in tube) for example. Output rate of different operation stages or work station of this plant is given below:

Sl.No.	Operation stage/ work station	Output	Time
1.	Filling and Belt cleaning	46 pcs.	1 Min.
2.	Inserting tube	38 pcs	1 SMS*
3.	Packet ready and stamping	24 pcs	1 SMS
4.	Packet closing and arranging	23 pcs	1 SMS
5.	Making 1 dozen Packet	1 Cartoon (72 pcs)	0.505
6.	Final Packing	1 Cartoon	0.746 SMS
7.	Tube forming, Cartoon preparation, etc.	40 pcs	1 SMS

* SMS = Standard Minutes

According to above discussed operation the ratio of manpower of these two work stations i.e. Snow (in tube) filling and inserting tube is determined uniformly with their production rate.

Snow (in tube) filling : Inserting tube

$$= \frac{46}{46} : \frac{46}{38}$$

$$= 1 : 1.21$$

$$= 1 : 1.25$$

Or, we can say that inserting time of that amount of snow (in tube) produced from filling machine in a given time to inserting tube will be 1.25 times. For equalization of two stages, manpower ratio should be fixed at the same rate.

If one technical operator for snow (in tube) filling operation is necessary than two workers for inserting tube operation is required. (As the ratio of worker is 1.25, excessive relaxation allowances will be available for the inserting tube worker excluding relaxation allowances).

Similarly the rate of manpower should be : Two workers for packet ready and stamping, two workers for packet closing and arranging, one worker for making one dozen packet, one worker for final packing work station. Besides one operator will be required to operate cartoon supply, cartoon preparation, waste cartoon disposal and other work station.

Requirement of manpower for production of snow (in tube) plant could be determined as follows:

Sl.No.	Operations	Output	Standard time	Manpower Balance
1.	Filling and Belt cleaning	46 pcs	1 min	1 Technical operator
2.	Inserting tube	38 pcs	1 SMS	2 workers
3.	Packet ready and stamping	24 pcs	1 SMS	2 workers
4.	Packet closing and arranging	23 pcs	1 SMS	2 workers
5.	Making 1 dozen packet	1 cartoon	0.505 SMS	1 worker
6.	Final Packing	1 cartoon	0.746 SMS	1 worker
7.	Tube forming, cartoon preparation, etc.	40 pcs	1 SMS	1 worker

In the same way requirement of manpower for production of snow (in bottle) and Powder plant could be determined which are given as follows:

CALCULATION OF MANPOWER REQUIREMENT ON THE BASIS OF TIME STUDY THROUGH PRODUCTION LINE BALANCING

Production line : Snow (in tube)

Output rate : : 19,682 Pcs/shift.

(Output rate is calculated considering 5% average down time for Electrical and Mechanical failure and 7½ Hrs. working time per shift).

Sl. No.	Operation	Output	*Standard time	Manpower Balance
1.	Filling and Belt cleaning	46 Pcs.	1 Min.	1 Tech. Operator
2.	Inserting tube	38 Pcs.	1 SMS	2 Workers
3.	Packet ready and stamping	24 Pcs.	1 SMS	2 Workers
4.	Packet closing and arranging	23 Pcs.	1 SMS	2 Workers
5.	Making 1 doz. Packet	1 Cartoon (72 Pcs.)	0.505 SMS	1 Worker
6.	Final Packing	1 Cartoon (72 Pcs.)	0.746 SMS	1 Worker
7.	Tube forming, Cartoon preparation, etc.	40 Pcs.	1 SMS	1 Worker

CALCULATION OF MANPOWER REQUIREMENT ON THE BASIS OF TIME STUDY THROUGH PRODUCTION LINE BALANCING

Production Line : Snow (in bottle)

Output Rate : 16,614 Pcs. per shift.

(Output rate is calculated considering 5% average down time for Electrical and Mechanical failure and 7½ Hrs. working time per shift)

Sl.No.	Operation	Output	Standard time	Manpower Balance
1.	Filling	44 Pcs.	1 Min.	1 Tech. Operator
2.	Cap Placing	23 Pcs.	1 SMS	2 Workers.
3.	Hopper and cleaning bottle	38 Pcs.	1 SMS	1 Worker
4.	Packet open and stamping	24 Pcs.	1 SMS	2 Workers.
5.	Cap putting on bottle	21 Pcs.	1 SMS	2 Workers
6.	Cap fitting	25 Pcs.	1 Min.	1 Tech. Operator.
7.	Level wrapping	10 Pcs.	0.218 SMS	1 Worker.
8.	Single Packet making	10 Pcs.	0.217 SMS	1 Worker.
9.	Making one doz. Packet	1 Packet (12 Pcs.)	0.623 SMS	1 Worker.
10.	Final Packing	1 Cartoon (72 Pcs.)	1.712 SMS	2 Workers.

CALCULATION OF MANPOWER REQUIREMENT ON THE BASIS OF TIME STUDY THROUGH PRODUCTION LINE BALANCING

Production Line : Powder

Output Rate : 19,170 Pcs. Per shift.

(Output rate is calculated considering 5% average down time for Electrical and Mechanical failure and 7½ Hrs. working time per shift).

Sl.No.	Operation	Output	Standard time	Manpower Balance.
1.	Filling(single and double container filling Machine)	29 Pcs.	1 min.	1 Tech.Operator
		48 Pcs.	1 min.	1 Tech.Operator
2.	Weighing and Inspection	36 Pcs.	1 SMS	1 Worker.
3.	Cap Sealing	31 Pcs.	1 SMS	1 Worker.
4.	Cleaning container	33 Pcs.	1 SMS	1 Worker.
5.	Cartoon ready and Stamping	38 Pcs.	1 SMS	1 Worker
6.	Placing inside the Cartoon	1 Cartoon (72 Pcs.)	1.54 SMS	2 Workers.
7.	Cartoon Covering, tapping and placing	1 Cartoon (72 Pcs.)	0.733 SMS	1 Worker.

* For petty, extra 2(two) workers will be required for nail filling and wire binding.

DETERMINATION OF MANPOWER BY TIME STUDY OF SOAP PROCESSING PLANT

To determine the manpower requirement by time study, output rate of P_1/P_2, P_3 & P_4 lines were fixed. In different operation stage/work station line belancing method was followed in determination of manpower requirement which is reasonable with output rate.

Let us take P_4 line for example.

Output rate of different operation stage or work station of this line is given below:

Sl.No.	Operation State/ Work Station	Output	Time
1.	T.V. Cutter	250 pcs	1 min.
2.	Feeding to Dry Chamber (Manual Operation)	200 pcs	1 SMS
3.	Receiving from Dry Chamber (Manual Operation)	125 pcs	1 SMS
4.	Stamping	200 pcs	1 min.
5.	Soap filling	100 pcs	1 SMS
6.	Patty Supply	1 Patty (180 pcs)	0.625 SMS
7.	Nail fitting	1 Patty	0.625 SMS
8.	Wire binding	1 Patty	0.78 SMS

According to above discussed operation, the ratio of manpower of these two work station i.e. T.V. Cutter and Dry Chamber is determined uniformly with their production rate.

T.V. Cutter : Feeding to dry chamber

$$= \frac{250}{250} : \frac{250}{200}$$

$$= 1 : 1.25$$

Or, we can say that feeding time of that amount of soap produced from T.V. Cutter in a given time to dry chamber will be 1.25 times. For equalization of two stages, manpower ratio should be fixed at the same rate. If 1 technical operator for T.V. Cutter operation is necessary then 2 worker for feeding to dry chamber operation is required. (As the ratio of worker is 1.25, excessive relaxation will be available for the feeder worker excluding relaxation allowances).

Similarly the rate of manpower should be : 2 worker, 1 technical operator and 2 worker respectively in receiving from drier, stamping and soap filling work station. Besides 1 operator will be required to operate patty supply, nail fitting, wire binding and other work station.

Requirement of manpower for P_4 line could be determined as follows:

Sl. No.	Operations	Output	Standard Time	Manpower Balance
1.	T.V.Cutter	250 Pcs.	1 min.	1 Tech.Operator
2.	Feeding to Dry Chamber	200 Pcs.	1 SMS	2 Workers
3.	Receiving from Drier	125 Pcs.	1 SMS	2 Workers
4.	Stamping	200 Pcs.	1 min.	1 Tech.Operator
5.	Soap Filling	100 Pcs.	1 SMS	2 Workers
6.	Petty Supply	1 Petty	0.625 SMS	1 Worker
7.	Nail fitting	1 Petty	0.625 SMS	1 Worker
8.	Wire Binding	1 Petty	0.78 SMS	1 Worker

Requirement of manpower for P1/P2 & P3 lines could be determined as follows :

CALCULATION OF MANPOWER REQUIREMENT
ON THE BASIS OF TIME STUDY THROUGH
PRODUCTION LINE BALANCING.

Production Line : P4
Output Rate : 85500 Pcs/Shift
(Output rate is calculated considering 5% average down time for Electrical & Mech. failure and 7½ hrs.working time per shift.)

Operations	Output	Standard time*	Manpower balance
T.V.Cutter	250 Pcs.	1 min.	1 Tech.Operator
Feeding to Dry Chamber	200 Pcs.	1 SMS	2
Receiving from Drier	125 Pcs.	1 SMS	2
Stamping	200 Pcs.	1 min.	1 Tech.Operator
Soap filling	100 Pcs.	1 SMS	2
Petty Supply	1 Petty (180 Pcs)	0.625 SMS	1
Nail fitting	1 Petty (180 Pcs)	0.625 SMS	1
Wire Binding	1 Petty (180 Pcs)	0.78 SMS	1

*Standard Time= $\frac{\text{Observed Time x Observed Rating}}{\text{Standard Rating}}$ + % Relaxation Allowence

In calculating the standard time, in this study the Standard Rating is considered to be 100 which means,the operators work briskly/business like performance,all through over the working hour.

However,it may be mantioned here that in recommending the requirement of actual No.of Manpower,the activity sampling results were considered and the workers are supposed to work at a steady rate and unhurried performance with time not being intentionally wasted.

(SMS = Standard Minutes)

CALCULATION OF MANPOWER REQUIREMENT ON THE BASIS OF TIME STUDY THROUGH PRODUCTION LINE BALANCING.

Production Line : P3
Output Rate : 42750 Pcs/Shift
(Output rate is calculated considering 5% average down time for Electrical & Mech. failure and 7½ hrs.working time per shift.)

Operation	Output	Standard time	Manpower balance
T.V.Cutter	125 Pcs.	1 min.	1 Tech.Operator
Autofeed to drier	-do-	-do-	
Lining Soap before Stamping	80 Pcs.	1 SMS	2
Stamping	100 Pcs.	1 min.	1 Tech.Operator
Lining Soap over the Conveyer	80 Pcs.	1 SMS	1
Arranging Soap before Wrapping	80 Pcs.	1 SMS	1
			1
Wrapping Operation	100 Pcs.	1 min.	1 Tech.Operator
Cartoon filling	1 Cartoon	0.75 SMS	1 Woker
Taping	1 Cartoon	0.625 SMS	1 Worker
Cartoon Supply (making & Polythene Packing)	1 Cartoon	1.50 SMS	2 Workers

CALCULATION OF MANPOWER REQUIREMENT ON THE BASIS OF TIME STUDY THROUGH PRODUCTION LINE BALANCING.

Prdduction Line : P1/P2
Ouput Rate :42750 Pcs/Shift
(Output rate is calculated considering 5% average down time for Electrical & Mech. failure and 7½ hrs.working time per shift.)

Operation	Output	Standard time	Manpower balance
T.V. Cutter	100 Pcs.	1 min.	1 Tech.Operator
Feeding to drier	80 Pcs.	1 SMS	2 Worker
Receiving from drier & Cartoon filling.	57 Pcs.	1 SMS	2 Worker
Cartoon Supply (making & Polythene filling)	1 Cartoon	1.50 SMS	2 Worker
Taping	1 Cartoon	0.625 SMS	1 Worker

For Petty, extra 2 Worker will be required for nail filling and wire binding.

SNOW (IN TUBE)

CALCULATION OF EXPECTED OUTPUT (SINGLE LINE) .

WORK STATION	STANDARD TIME. MINUTE	NO. OF WORKERS ALLOCATED	EXPECTED OUTPUT FOR FULL 8 HOURS OPERATION (GROSS)	OBSERVED FILLING AND SEALING MACHINE CAPACITY. (GROSS)	REMARKS
PUTTING THE TUBE INSIDE THE PACKET.	.044	2	151		
COVER ANOTHER SIDE AND PLACING .	.062	3	161		
PACKET MAKING READY AND COVER ONE SIDE.	.055	2	122		
PLACING TUBES (12) ON THE WRAPPING PAPER. WRAPPING AND PUTTING STICKERS PLACING A SIDE.	.124 + .381 =0.505	2	158	154	
PLACING CARTOON AND PUTTING 6 DOZ. INTO CARTOON. COVERING TAPPING PLACING THE CARTOON AT POSITION.	.413 + .236 + .746 + .113 = 1.508	1	159		

SNOW (IN BOTTLE)

CALCULATION OF EXPECTED OUTPUT: (SINGLE LINE)

ORK STATION.	STANDARD TIME. MINUTE	NOS. OF WORKERS ALLOCATED	EXPECTED OUTPUT FOR FULL 8 HOURS OPERATION.(GROSS)	OBSERVED FILLING MACHINE CAPACITY	REMARKS
AKE 12 PACKETS AND LACING AKING ONE DOZ.PACKET RAPPING AND TAPPING	.294 + .623 =0.917	3	130	154	Observed two Cap fitting machine capacity = 167 Gross.
ACKING OF 6 DOZ. ARTOON AND PLACING	.142 + .442+ .293 + .693+ .142 =1.712	1	140		
EVELLING	.218	8	122		
INGLE PACKET AKING .	.217	8	121		
EVELLING TOP AND LACING TOP COVER.	0.145	5	115		

P O W D E R.

CALCULATION OF EXPECTED OUTPUT (DOUBLE FILLING).

WORK STATION.	STANDARD TIME . MINUTE	NO. OF WORKERS ALLOCATED	EXPECTED OUT-PUT FOR FULL 8 HOURS OPERA-TION (GROSS)	OBSERVED FILLING MACHINE CAPACITY. (GROSS)	REMARK:
CAP SEALING	.044	2	151	160/96	
WEIGHING	.054	2	126		
CLEANING	.044	2	151		
PACKING	3.099	2	154		
CONTAINER STAMPING.	.026	1	128		

CALCULATION OF EXPECTED OUTPUT FOR FULL 8 HOURS OPERATION.

Some examples of calculation are given below :-

1) For Snow (in tube) production process , the work station of 'Putting the tube inside the packet' the expected output for full 8 hours operation is

$$= \frac{\text{No of Pices x 60x8 x no. of person allocated.}}{\text{Standared time (minute)}}$$

$$= \frac{1 \times 60 \times 8 \times 2}{0.044 \times 144} \text{ Gross}$$

= 151 Gross .

ii) For Snow (in bottle) Production process, calculation of ' Single packet making ' is

$$= \frac{1x60x8x8}{0.217 \times 144} \text{ Gross}$$

= 121 Gross

iii) For Powder production process , calculation of ' final packing ' is

$$= \frac{72 \times 60 \times 8 \times 2}{3.099 \times 144} \text{ Gross}$$

= 154 Gross

And so on

SNOW (IN TUBE) - FILLING & PACKING PART

STANDARD TIME CALCULATION.

DESCRIPTION	BASIC TIME. MINUTE	RELAXATION ALLOWANCES	STANDARD TIME. MINUTE	TOTAL STANDARD TIME. MINUTE	RECOMMENDED CYCLE TIME. MINUTE	REMARK
PUTTING THE TUBE INSIDE THE PACKET.	.0344	28%	.044			
COVER ANOTHER SIDE AND PLACING .	.0487	28%	.062			
PACKET MAKE READY AND COVER ONE SIDE.	.0426	28%	.055			
PLACING TUBES (12) ON THE WRAPPING PAPER	.0967	28%	.124			
WRAPPING AND PUTTING STICKERS - PLACING A SIDE.	.298	28%	.381			
PLACING CARTOON AND PUTTING 6 DOZ. INTO THE CARTOONS.	.323	28%	.413	2.975	2.975	
COVERING	.184	28%	.236			
TAPPING	.583	28%	.746			
PLACING THE CARTOON AT POSITION.	.088	28%	.113			
COROGATED CARTOON MAKE READY (ONE SIDE)	.258	26%	.325			
HOLDING AND TAPPING (ONE SIDE)	.378	26%	.476			

SNOW (IN BOTTLE) - FILLING AND PACKING PART

STANDARD TIME CALCUTATION.

STANDARD TIME CALCULATION.

DESCRIPTION OF WORK STATIONS.	BASIC TIME . MINUTE	RELAXATION ALLOWANCE.	STANDARD TIME . MINUTE	TOTAL STANDARD TIME. MINUTE	RECOMMENDED CYCLE TIME.	REMARKS
LEVEL TOP SIDE OF PLACING TOP	.115	26%	.145			
LEVELING THE BOTTLE	.173	26%	.218			
PACKET MAKING READY AND STAMPING.	.29	29%	.374			
SINGLE PACKET MAKING	.148	29%	.217			
TAKING 12 PACKETS AND PLACING.	.228	29%	.294			
MAKING ONE DOZ. WRAPPING AND TAPPING	.483	29%	.623	4.362	4.362	
CARTOON MAKE READY.	.11	29%	.142			
PLACING 6 DOZ. INSIDE THE CARTOON.	.343	29%	.442			
COVER THE CARTOON	.2275	29%	.293			
TAPPING THE CARTOON	.5375	29%	.693			
REMOVE THE CARTOON AND PLACING	.11	29%	.142			
COROGATED CARTOON MAKE READY. (ONE SIDE)	.235	26%	.296			
HOLDING AND TAPPING OF CARTOON . (ONE SIDE)	.383	26%	.483			

POWDER - FILLING AND PACKING PART.

STANDARD TIME CALCULATION.

DESCRIPTION OF EACH WORK STATION.	BASIC TIME. MINUTE	RELAXATION ALLOWANCE	STANDARD TIME. MINUTE	TOTAL STANDARD TIME. MINUTE	RECOMMENDED CYCLE TIME. MINUTE	REMARI
WEIGHING EACH CONTAINER.	.043	26%	.054			
CONTAINER STAMPING	.021	26%	.026			
CAP SEALING	.035	26%	.044			
CLEANING EACH CONTAINER.	.035	26%	.044			
CARTOON(6 DOZ.) PLACING	.093	31%	.122	4.061	4.061	
PLACING 36 NOS. INSIDE THE CARTOON	.72	31%	.943			
PLACING ANOTHER 36 NOS. INSIDE THE SAME CARTOON.	.82	31%	1.074			
COVERING	.103	31%	.135			
TAPPING	.52	31%	.681			
PLACING THE CARTOON A SIDE.	.11	31%	.144			
COROGATED CARTOON MAKE READY (ONE SIDE)	.238	26%	.299			
HOLDING AND TAPPING OF CARTOON. (ONE SIDE)	.353	26%	.445			

SNOW (IN TUBE) - FILLING & PACKING PART.

(OBSERVED TIME)

(Scale:- 1 - 100)
Standard Rating- 100.

Date: 02. 7. 1991.

DESCRIPTION	WORKER'S CODE	OBSERVED TIME. MINUTE.	AVERAGE OBSERVED TIME.(MIN	OBSERVED RATING	BASIC TIME. MINUTE	TOTAL BASIC TIME OF EACH WORK STATION. MINUTE	REMARKS
PUTTING THE TUBE INSIDE THE PACKET.	WORKER- - 819	.03 .02 .03 .03 .03 .02 .03 .03	.0275	125	.0344	.0344	
COVER ANOTHER SIDE AND PLACING	WORKER - 828	.05 .04 .04 .05 .05 .05 .04 .05	.04625	100	.04625		
	WORKER - 678	.04 .04 .05 .05 .04 .04 .05 .04	.04375	125	.0547	.0487	
	WORKER -176	.05 .05 .04 .05 .05 .04 .04 .04	.045	100	.045		
PACKET MAKE READY AND COVER ONE SIDE.	WORKER - 719	.03 .04 .03 .03 .03 .04 .03 .03	.0325	125	.0406		

Date: 03-7-1991

ESCRIPTION	WORKER'S CODE	OBSERVED TIME. MINUTE	AVERAGE OBSERVED TIME. MINUTE	OBSERVED RATING	BASIC TIME. MINUTE	TOTAL BASIC TIME OF EACH WORK STATION. MINUTE	REMARKS
	WORKERS - 785	.04 .03 .03 .04 .03 .03 .03 .03	.03875	125	.0484		
	WORKER -821	.04 .04 .03 .04 .05 .03 .04 .04	.03875	100	.03875	.0426	
PLACING TUBES (12) ON THE WRAPPING PAPER .	WORKER -798	.06 .08 .06 .06 .10 .08 .10 .08 .08 .08 .09 .06	.0775	125	.0967	.0967	
WRAPPING & PUTTING STICKERS, PLACING A SIDE.	WORKER - 278	.25 .24 .28 .26 .25 .25 .22 .20 .22 .20 .24 .25	.238	125	.298	.298	
PLACE CARTOON AND PUTTING 6 DOZ. INTO THE CARTOON.	WORKER -326	.50 .50 .40 .40 .50	.46	75	.345		

Date: 04-7-1991.

DESCRIPTION	WORKER CODE	OBSERVED TIME. MINUTE	AVERAGE OBSERVED TIME. MINUTE	OBSERVED RATING	BASIC TIME . MINUTE	TOTAL B.T OF EACH WORK STATION. MINUTE	REMARK
	WORKER - 50	.30 .35 .30 .25 .30 .30	0.3	100	0.3	.323	
COVERING	WORKER -326	.25 .20 .20 .25 .30	.25	.75	.188	.184	
	WORKER - 50	.22 .15 .20 .15 .15 .20	.18	100	.18		
TAPPING	WORKER -326	.70 .70 .65 .70 .65	.68	75	.51	.583	
	WORKER - 50	.55 .60 .55 .65 .60 .55	.655	100	.655		
PLACING THE CARTOON AT POSITION.	WORKER -326	.12 .12 .08 .10 .12	.108	75	.081	.088	
	WORKER - 50	.10 .08 .08 .10 .08 .10	.095	100	.095		

DESCRIPTION	WORKER CODE	OBSERVED TIME . MINUTE	AVERAGE OBSERVED TIME. MINUTE	OBSERVED RATING	BASIC TIME. MINUTE	TOTAL BASIC TIME OF EACH WORK STATION. MINUTE	REMARK
COROGATED CARTOON MAKE READY (ONE SIDE)	WORKER -687	.25 .25 .30 .25 .26 .24	.258	100	.258	.258	
HOLDING AND TAPPING (ONE SIDE)	WORKER -561	.40 .35 .38 .40 .36 .38	.378	100	.378	.378	

SNOW (IN BOTTLE) - FILLING AND PACKE
PACKING PART.

OBSERVED TIME CALCULATION.

(SCALE :- 1 - 100)

STANDARD RATING - 100.

DATE: 09-7-1991.

DESCRIPTION	WORKER'S CODE	OBSERVED - TIME. MINUTE	AVERAGE OBSERVED TIME. MINUTE	OBSERVED RATING	BASIC TIME MINUTE	REMARK
LEVELING TOP SIDE AND PLACING CAP.	WORKER -803	.08 .10 .10 .09	.092	125	.115	
LEVELING THE BOTTLE	WORKER - 820	.20 .15 .16 .18	.173	100	.173	
PACKET MAKE READY AND STAMPING .	WORKER -727	.30 .28 .32 .26	.29	100	.29	
SINGLE PACKET MAKING	WORKER -561	.12 .10 .10 .15	.118	125	.148	
TAKING 12 PACKETS AND PLACING .	WORKER - 791	.20 .25 .22 .24	.2275	100	.228	
MAKING ONE DOZ. PACKET WRAPPING AND TAPPING.	WORKER - 791	.48 .50 .50 .45	.4825	100	.483	
CARTOON MAKING READY	WORKER - 295	.12 .10 .10 .12	.11	100	.11	
PLACING 6 DOZ. INSIDE THE CARTOONS.	WORKER - 295	.35 .35 .32 .35	.3425	100	.343	

DESCRIPTION	WORKERS CODE	OBSERVED TIME. MINUTE	AVERAGE OBSERVED TIME. MINUTE	OBSERVED RATING.	BASIC TIME MINUTE	REMAR
COVER THE CARTOON	WORKER - 295	.20 .22 .25 .24	.2275	100	.2275	
TAPPING THE CARTOON	WORKER - 295	.52 .55 .55 .53	.5375	100	.5375	
REMOVE THE CARTOON AND PLACING.	WORKER - 295	.10 .12 .10 .12	.11	100	.11	
COROGATED CARTOON MAKING READY (ONE SIDE)	WORKER -678	.25 .25 .20 .24	.235	1000	.235	
HOLDING AND TAPPING OF CARTOON . (ONE SIDE)	WORKER - 678	.40 .35 .40 .38	.3825	100	.383	

POWDER (FILLING AND PACKING PART)
OBSERVED TIME CALCULATION.

Scale :- 1 - 100.
Standard Rating=100.

Date: 16-7-1991.

DESCRIPTION	WORKERS CODE	OBSERVED TIME. MINUTE	AVERAGE OBSERVED TIME. MINUTE	OBSERVED RATING	BASIC TIME. MINUTE	REMARK
WEIGHING EACH CONTAINER.	WORKER - 50	.03 .04 .03 .04	.035	125	.043	
CONTAINER STAMPING	WORKER - 828	.02 .02 .02 .02	.02	125	.025	
CAP SEALING	WORKER - 796	.04 .03 .03 .04	.035	100	.035	
CLEANING EACH CONTAINER.	WORKER - 785	.03 .04 .04 .03	.035	100	.035	
CARTOON (6 DOZ) PLACING	WORKER - 827	.10 .08 .10 .09	.093	100	.093	
PLACING 36 NOS. INSIDE THE CARTOON.	WORKER -827	.74 .70 .72 .72	.72	100	.72	
PLACING ANOTHER 36 NOS. (INSIDE THE CARTOON)	WORKER -827	.84 .80 .82 .82	.82	100	.82	
COVERING	WORKER - 827	.10 .12 .10 .09	.103	100	.103	
TAPPING.	WORKER - 827	.51 .54 .50 .53	.52	100	.52	
PLACING THE CARTOON A SIDE.	WORKER -827	.12 .10 .12 .10	.11	100	.11	

DESCRIPTION	WORKERS CODE.	OBSERVED TIME. MINUTE	AVERAGED OBSERVED TIME. MINUTE	OBSERVED RATING	BASIC TIME : MINUTE	REMARKS
COROGATED CARTOON MAKE READY (ONE SIDE)	WORKER - 819	.25 .24 .22 .24	.2375	100	.238	
HOLDING AND TAPPING OF CARTOON (ONE SIDE)	WORKER - 819	.36 .34 .35 .36	.3525	100	.353	

OBSERVED

: MACHINE - CAPACITY. :

SNOW (IN TUBE) FILLING MACHINE.

D A T E	ROUND (TIME)	OBSERVED FILLING & SEALING PER MINUTES Pcs.	AVERAGE OBSERVED FILLING PER MINUTES. Pcs.	OVER ALL AVERAGE	DESIGNED CAPACITY Pcs.	REMARKS.
22-7-91	10-51	46	45.5	44	NOT - AVAILABLE.	
	10-52	46				
	10-53	44				
	10-54	46				
	11-01	46	43.0			
	11-02	40				
	11-03	42				
	11-04	44				
	11-31	46	40.0			
	11-32	40				
	11-33	44				
	11-34	30				
	11-46	46	46.0			
	11-47	46				
	11-48	46				
	11-49	46				
23-7-91	09-46	46	45.5			
	09-47	44				
	09-48	46				
	09-49	46				
	10-31	42	44.5			
	10-32	46				
	10-33	44				
	10-34	46				

O B S E R V E D M A C H I N E C A P A C I T Y.

SNOW (IN BOTTLE)FILLING MACHINE, DATE: 24.7.1991.

ROUND	OBSERVED FILLING PER MINUTE. Pcs.	AVERAGE OBSERVED FILLING PER MINUTE. Pcs.	OVER ALL AVERAGE	DESIGNED CAPACITY	REMARKS.
08-41	42				
08-42	44	43			
08-43	42				
08-44	44		42.6 = 43	N O T - A V A I L A B L E .	
09-30	45				
09-31	43	43.75			
09-32	43				
09-33	44				
10-01	42				
10-02	42	41			
10-03	40				
10-04	40				
CAP FITTING MACHINE.					
08-50	25				
08-51	25	24.75			
08-52	24				There are T w o Machines.
08-53	25		24.25 = 25	N O T - A V A I L A B L E .	
09-55	22				
09-56	24				
09-57	25	23.75			
09-58	24				

OBSERVED MACHINE CAPACITY

POWDER FILLING MACHINE DATE: 25.7.91

(Single container filling Machine.)

ROUND	OBSERVED FILLING PER MINUTE. Pcs.	AVERAGE OBSERVED FILLING PER MINUTE Pcs.	OVER ALL AVERAGE FILLING PER MINUTE. Pcs.	DESIGNED CAPACITY	REMARKS.
09-51	28	28	28.5 = 29	NOT - AVAILABLE.	
09-52	30				
09-53	28				
09-54	26				
10-33	30	29.			
10-34	28				
10-35	30				
10-36	28				
(DOUBLE CONTAINER FILLING MACHINE) (SINGLE OPERATOR)					
10-16	48	47	47.38 = 48	NOT - AVAILABLE.	
10-17	46				
10-18	50				
10-19	44				
10-42	47	47.75			
10-43	48				
10-44	46				
10-45	50				

CALCULATION OF MINIMUM NUMBER OF OBSERVATION

The following universel formula is used to calculate the minimum number of observation .

$$N = \frac{4P\,(\,100 - P\,)}{L^2}$$

(Valid for 95% Confidence limit)

Here ,

N = Number of observation

P = Occurance of an event (%) = 90.6%

L = Accuracy limit

For this study L = $\pm$ 7 % is considered.

$$N = \frac{4 \times 90.6 \times 9.4}{49} = 69$$

Hence the minimum number of observation is 69

EXISTING BASE PART MIXING TIME OF COSMETIC PROCESSING PLANT

Date: 27.7.199

SECTION	PRODUCT	MIXING TIME (HOURS)	REMARKS
TUBE	Snow (intube) Tooth Paste Sheaving creame	3 3 8	Observation was not done.
BOTTLE	SNOW(in Bottle) Cream (Pommet)	3 4	
POWDER	Powder (Container)	4	

TABLE - N (a) EXAMPLE OF TABLES USED TO CALCULATE RELAXATION ALLOWANCES

A. PHYSICAL STRAINS RESULTING FROM THE NATURE OF THE WORK

1. POSTURE:(

Consider whether the worker is sitting, standing, stopping or in a cramped position and whether a load is handled easily or awkwardly.

	Points
Sitting easily	0
Sitting awkwardly, or mixture of sitting and standing	2
Standing or walking freely	4
Ascending or descending stairs unladen	5
Standing or walking with a load	6
Climbing up or down ladders, or some bending, lifting stretching or throwing	8
Awkward lifting, shovelling ballast to container	10
Constant bending, lifting, stretching or throwing	12
Coalmining with pickaxes, lying in a low seam	16

2. VIBRATION:

Consider the impact of the vibration on the body, limbs or hands and the addition to mental effort due to it, or to a serie of jars or shocks.

Shovelling light materials	1
Power sewing-machine Power press or guillotine if operative is holding the material Cross-cut sawing	2
Shovelling ballast Portable power drill operated by one hand	4
Pickaxing	6
Power drill(two hands)	8
Road drill on concrete	15

3. SHORT CYCLE(HIGHLY REPETITIVE) :

In highly repetitive work, if a series of very short elements form a cycle which is continuously repeated for a long period, award points as indicated below, to compensate for the lack of opportunity to vary the muscles used during the work.

Average cycle time (centiminutes)	Points
16-17	1
15	2
13-14	3
12	4
10-11	5
8-9	6
7	7
6	8
5	9
Less than 5	10

4. RESTRICTIVE CLOTHING:

Consider the weight of the protective clothing in relation to effort and movement. Consider also whether ventilation and breathing are affected.

Thin rubber(surgeon's) gloves	1
Household rubber gloves Rubber boots	2
Grinder's goggles	3
Industrial rubber or leather gloves	5
Face mask(e.g. for paint-spraying)	8
Asbestos suit or tarpaulin coat	15
Restrictive protective clothing and respirator	20

B. MENTAL STRAINS

1. CONCENTRATION/ANXIETY:

Consider what would happen if the operative relaxed his attention, the responsibility carried, the need for exact timing of movements, and the accuracy or precision required.

	Points
Routine simple assembly Shovelling ballast	0
Routine packing, labourer washing vehicles Wheeling trolley down clear gangway	1
Feed press tool; hand clear of press Topping up battery	2
Painting walls	3
Assembling small and simple batches, performed without much thinking Sewing-machine work, automatically guided	4
Assembling warehouse orders by trolley Simple inspection	5
Load/unload press tool, hand feed into machine Spray-painting metalwork	6
Adding up figures Inspecting detailed components	7
Buffing and polishing	8
Guiding work by hand and sewing machine Packing assorted chocolates, memorising pattern and selecting accordingly Assembly work too complex to become automatic Welding parts held in jig	10
Driving a motor bus in heavy traffic or fog Marking out in detail with high accuracy	15

2. MONOTINY :

Consider the degree of mental stimulation and if there is companionship, competitive spirit, music, etc.

	Points
Two men on jobbing work	0
Cleaning own shoes for half an hour on one's own	3
Operative on repetitive work Operative working alone on non-repetitive work	5
Routine inspection	6
Adding similar columns of figures	8
One operative working alone on highly repetive work	11

3. EYE STRAIN :

Consider the lighting conditions, glare, flicker, illumination, colour and closeness of work and for how long the strain is endured.

Normal factory work	0
Inspection of easily visible faults Sorting distinctively coloured articles by colour Factory work in poor lighting	2
Intermittent inspection for detailed faults Grading apples	4
Reading a newspaper in a motor car/bus	8
Arc-welding using mask Continuous visual inspection, e.g. cloth from a loom	10
Engraving using an eyeglass	14

4. NOISE:

Consider whether the noise affects concentration, is a steady hum or a background noise, is regular or occurs unexpectedly, is irritating or soothing.

	Points
Work in a quiet office, no distracting noise Light assembly factory	0
Work in a city office with continual traffic noise outside	1
Light machine shop Office or assembly shop where noise is a distraction	2
Woodworking machine shop	4
Operating steam hammer in forge	5
Revetting in a shipyard	9
Road drilling	10

C. PHYSICAL OR MENTAL STRAINS RESULTING FROM THE NATURE OF THE WORKING CONDITIONS.

1. TEMPERATURE AND HUMIDITY :

Consider the general conditions of atmospheric temperature and humidity and classify as indicated below. Select points according to average temperature within the ranges shown.

Humidity (Percent)	Temperature Upto 75°F	76 to 90°F	Over 90°F
Upto 75	0	6 - 9	12 - 16
76 - 85	1 - 3	8 - 12	15 - 26
Over 85	4 - 6	12 - 17	20 - 36

2. VENTILATION :

Consider the quality and freshness of the air and its circulation by air-conditioning or natural draught.

Offices	Points
Factoreis with "office-type" conditions	0
Workshop with reasonable vantilation but some draught	1
Draughty workshops	3
Working in sewer	14

3. FUMES :

Consider the nature and concentration of the fumes: whether toxic or injurious to health; irritating to eyes, nose, throat or skin, disagreeable oder.

Lathe turning with coolants	0
Emulsion paint, Gas cutting, Soldering with resin	1
Motor vehicle exhaust in small commercial garage	5
Cellulose painting	6
Moulder procuring metal and filling mould	10

4. DUST :

Consider the volume and nature of the dust.

	Points
Office Normal light assembly operations Press shop	0
Grinding or buffing operation with good extraction	1
Sawing wood	2
Emptying ashes	4
Linishing weld	6
Running coke from hoppers into skips trucks	10
Unloading cement	11
Demolishing building	12

5. DIRT :

Consider the nature of thework and the general discomfort caused by its dirty nature. This allowance covers "Washing time" where this is paid for(i.e. where operatives are allowed three minutes or five minutes for washing ,etc.). Do not allow both points and time.

Office work Normal assembly operations	0
Office duplicators	1
Dustman	2
Stripping internal combustion engine	4
Work under old motor vehicle	5
Unloading bags of cement	7
Coalminer Chimney-Sweep with brushes	10

6. WET :

Consider the cumulative effects of exposure to this condition over a long period.

	Points
Normal factory operations	0
Outdoor workers e.g. postman	1
Working continuously in the damp	2
Rubbing down walls with wet pumice block	4
Continuous handling of wet articles	5
Laundry wash-house, wet work, steamy, floor running with water, hands wet	10

POINTS CONVERSION TABLE

TABLE- N(b)

PERCENTAGE RELAXATION ALLOWANCE FOR TOTAL POINTS ALLOCATED

Points	0	1	2	3	4	5	6	7	8	9
0	10	10	10	10	10	10	10	11	11	11
10	11	11	11	11	11	12	12	12	12	12
20	13	13	13	13	14	14	14	14	15	15
30	15	16	16	16	17	17	17	18	18	18
40	19	19	20	20	21	21	22	22	23	23
50	24	24	25	26	26	27	27	28	28	29
60	30	30	31	32	32	33	34	34	35	36
70	37	37	38	39	40	40	41	42	43	44
80	45	46	47	48	48	49	50	51	52	53
90	54	55	56	57	58	59	60	61	62	63
100	64	65	66	68	69	70	71	72	73	74
110	75	77	78	79	80	82	83	84	85	87
120	88	89	91	92	93	95	96	97	99	100
130	101	103	105	106	107	109	110	112	113	115
140	116	118	119	121	122	123	125	126	128	130

Example: If the total number of points allocated for the various strains is 37:

(i) In the left-hand column of table , find the line for 30;

(ii) On this line, move across the table to the right, to column 7;

(iii) Read off the relaxation allowance for 37 points, which is 18 percent.

CALCULATION OF LEAVE & ABSENTEEISM RATE FOR
COSMETIC PLANT FROM JULY'1989 TO JUNE'1990

Total Manpoer = 153 (Excluding supervisor and Foreman)

MONTH	PRESENTEEISM	PERCENTAGE OF LEAVE AND ABSENTEEISM	AVERAGE %	REMARKS
July'89	87	43.14		Eid-ul-Azha
August'89	136	11.11		
September'89	134	12.41		
October'89	133	13.07		
November'89	131	14.38	16.99	
December'89	132	13.73		
January'90	128	16.34		
February'90	132	13.73		
March'90	134	12.42		
April'90	114	25.49		Eid-ul-Fitre
May'90	136	11.11		
June'90	127	16.99		

CALCULATION OF LEAVE & ABSENTEEISM RATE FOR SOAP PROCESSING PLANT FROM JULY- 1989 TO JUNE - 1990

TOTAL MANPOWER = 276 (Excluding Supervisor & Foreman)

Month	Presenteeism	Percentage of Leave & Absenteeism	Average Percentage	Remarks
July	164	40.579		Eid-Ul-Azha
August	215	22.102		
September	219	20.652		
October	242	12.319		
November	239	13.406		
December	223	19.203	19.830	
January	225	18.478		
February	239	13.406		
March	230	16.666		
April	199	27.898		Eid-Ul-Fitre
May	219	20.652		
June	241	12.681		

TABLE - P

DAILY ATTENDENCE STATEMENT OF WORKERS

Date: 22.8.91.

SECTION	SHIFT A(0600 - 1430)	SHIFT B(1400 - 2230)	SHIFT C(2200-0600)	Gen. (0830-1730)	Total	Leave Absen-tism	Actual Man-Power
1. Washing Soap	69	72	-	-	141	38	179
2. Toilet Soap	51	11	-	-	62	18	80
3. Glycerine Soap	-	-	-	5	5	3	8
4. Penshed	19	19	-	-	38	10	48
5. Cosmetic	-	-	-	110	110	36	146
6. Glycerine Plant	6	9	-	6	21	2	23
7. Electrical	5	5	2	5	17	3	20
8. Pump House	4	4	3	-	11	-	11
9. Boiler	4	3	-	4	11	3	14
10. Workshop	-	-	-	10	10	1	11
11. Tedhnical Store	-	-	-	9	9	-	9
12. Perfume	-	-	-	3	3	-	3
13. Bottle Store	-	-	-	1	1	-	1
14. Cafetaria	-	-	-	2	2	-	2
	158	123	5	155	441	114	555

Attendence of Previous days: 21.8.91 Percentage of Presentism : 79%

Average present : 79%

Present : 438

Absent : 117

Total- 555

TABLE-Q

TOTAL MANPOWER (UPTO FOREMAN) LIST
UPTO 31ST DECEMBER, 1990

		STAFF	WORKER	TOTAL
a)	As per Set-up	96	560	656
b)	Unproductive Worker (MNSP)	96		
c)	Productive Worker (IWW & PC)		560	
				656

DETAILS MANPOWER (UPTO FOREMAN) LIST

FROM 01-10-90 TO 31-12-90

	SECTION	MANPOWER	
1.	Cosmetic Section	Foreman	- 1
		Chief Supervisor/ Supervisor	- 11
		Master Technician	- 8
		Mechanics	- 1
		Operator	- 20
		Cleaner	- 3
		H.S.T	- 5
		S.T-II	- 21
		S.S.T	- 5
		Unskilled	- 8
			133
2.	Cosmetic Packing	H.S.T	- 6
		S.T.-I	- 1
		S.S.T	- 2
			9
3.	Plastic Section	Operator	- 2
		Cleaner	- 2
		S.S.T	- 10
		Unskilled	- 1
			15
4.	Ink Section	Operator	- 4
		H.S.T.	- 7
		S.T.-II	- 1
			12
5.	Perfume Section	Master Technician	- 1
		Helper	- 2
			3
6.	Glycerine Soap		
		Technical Asstt.	- 1
		Operator	- 12
		Helper	- 1
		H.S.T.	- 1
		Unskilled Technician	- 1
			16

SECTION	MANPOWER		
7. Washing Soap	Foreman	- 3	
	Chief Supervisor/ Supervisor	- 6	
	Master Technician	- 15	
	Operator	- 14	
	Mechanics	- 1	
	Cleaner	- 3	
	H.S.T.	-108	
	S.T.-I	- 19	
	S.S.T.	- 26	
			196
8. Toilet Soap	Foreman	- 2	
	Chief Supervisor/ Supervisor	- 5	
	Master Technician	- 5	
	Operator	- 17	
	Mechanic	- 1	
	H.S.T.	- 38	
	S.T.-I	- 1	
	S.T.-II	- 6	
			75
9. Penshed Section	Foreman	- 1	
	Master Technician	- 5	
	Mechanics	- 2	
	Operator	- 10	
	Cleaner	- 2	
	H.S.T.	- 5	
	S.T.-I	- 2	
	S.T.-II	- 2	
	S.S.T	- 9	
	Unskilled	- 4	
			44

SECTION	MANPOWER		
10. Glycerine Plant	Foreman	- 1	
	Master Technician	- 2	
	Operator	- 4	
	Helper(Mechanical)	- 2	
	Assistant Mechanics	- 1	
	H.S.T.	- 7	
	S.T.-I	- 2	
	S.S.T.	- 4	
	Unskilled	- 2	
			25
11. Workshop	Foreman	- 1	
	Mechanics	- 2	
	Turner	- 2	
	Fitter	- 1	
	Mechanical Helper	- 1	
	Asstt. Turner	- 1	
	Molder	- 1	
	S.S.T	- 1	
			10
12. Electrical Section	Foreman	- 1	
	Electrician	- 4	
	Assistant Electrician	- 5	
	Electric Helper	- 4	
	Generator Operator	- 3	
			18
13. Boiler Section	Foreman	- 1	
	Master Technician	- 2	
	Boiler Assistant	- 5	
	Boiler Helper	- 2	
	Boiler Operator	- 1	
	Asstt. Boiler Attent.	- 4	
			15
14. Pump House	Master Technician	- 1	
	Pump Driver	- 7	
	Pump Fitter	- 1	
			9

FIG.R(a) GENERAL PURPOSE TIME STUDY TOP SHEET.

BANGLADESH UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF INDUSTRIAL & PRODUCTION ENGINEERING

TIME STUDY SHEET (TIME STUDY TOP SHEET)

NAME OF JOB	DEPARTMENT	STUDY NO.
		SHEET NO.
OPERATOR CLOCK NO. OBSERVER		DATE
		TIME START
LIST OF ELEMENTS	BREAK POINTS	TIME FINISH
.....	.....	DURATION
.....	.....	ERROR
.....	.....	% ERROR
.....	.....	STUDY CONDITIONS
.....	.....	
.....	.....	
.....	.....	
.....	.....	

SKETCH OF WORKPLACE OR PRODUCT OR OTHER SALIENT INFORMATION

DESCRIPTION	O.T.	R.	B.T.	DESCRIPTION	O.T.	R.	B.T.

O.T. = OBSERVED TIME.
R. = RATING.
B.T. = BASIC TIME.

FIG. R(b) CONTINUATION SHEET FOR GENERAL-PURPOSE TIME STUDY.

SHEET NO. II

TIME STUDY CONTINUATION SHEET.

DESCRIPTION	O.T.	R.	B.T.	DESCRIPTION	O.T.	R.	B.T

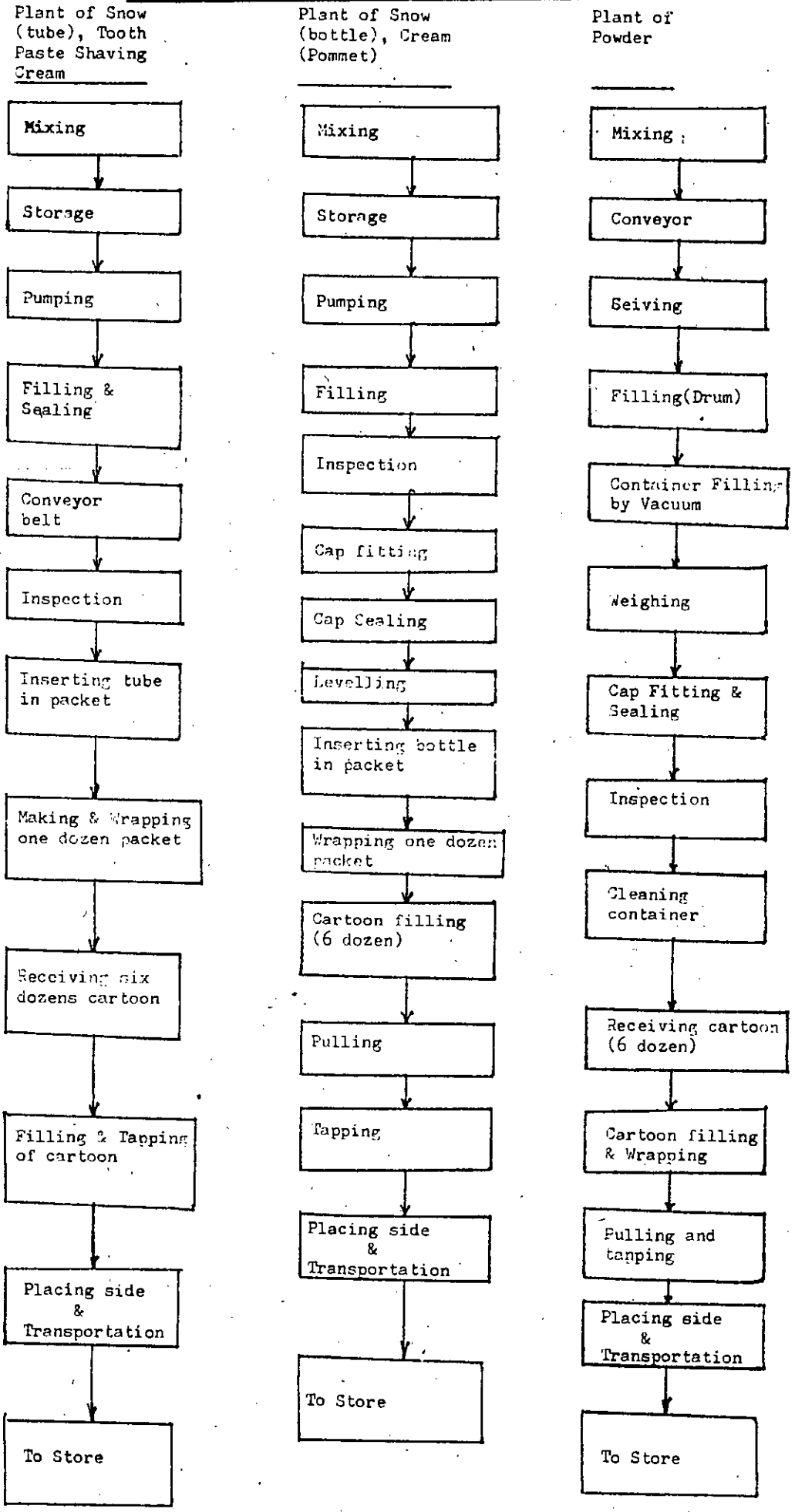
O.T. = OBSERVED TIME.

R. = RATING.

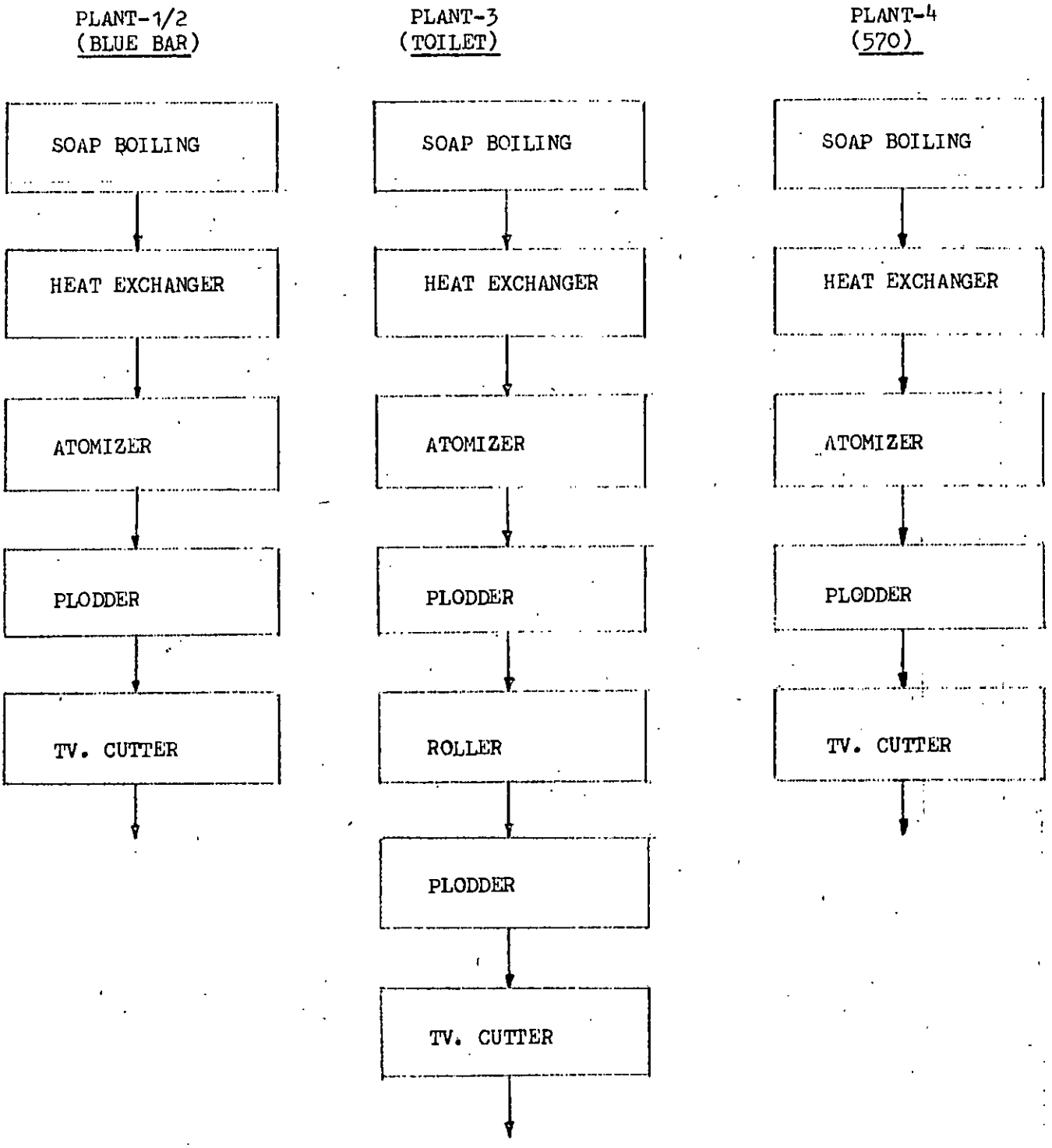
B.T. = BASIC TIME.

Figure- S

PROCESS FLOW CHART FOR COSMETIC PROCESSING PLANT

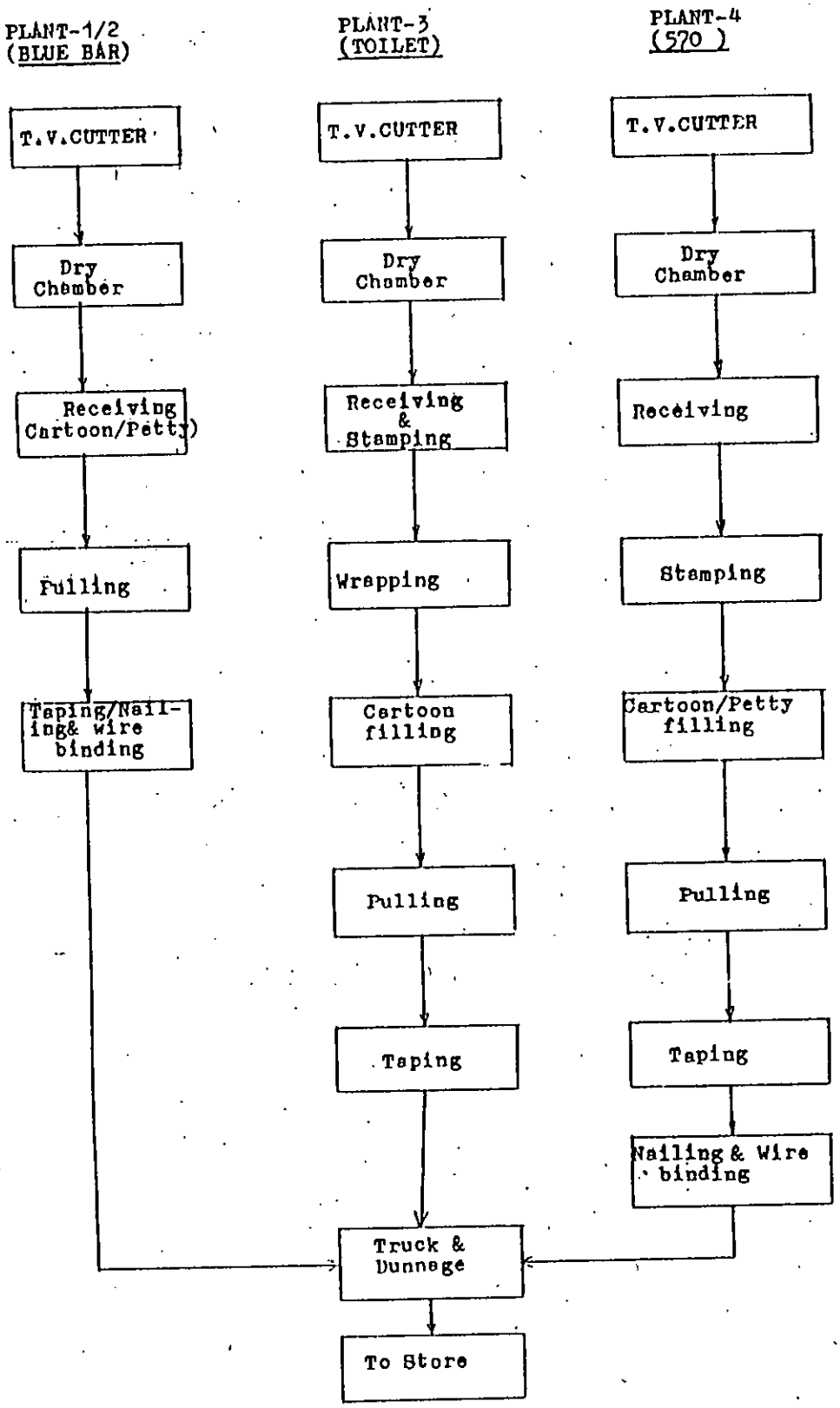


PROCESS FLOW CHART FOR SOAP PROCESSING



CONTD.. PAGE 3 of 3

PROCESS FLOW CHART FOR SOAP PROCESSING



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