

Aspects of a Good Maintenance

Introduction

Since any mode of maintenance is basically a well laid system but it was thought necessary that apart from indicating a workable system for preventive, corrective and predictive maintenance, those aspects which affect them most must be highlighted. In this paper Authors have tried to raise some thought provoking ideas and practices being followed by others.

Any maintenance system recommended for a mill should cater for :

- i) Efficient maintenance of equipment and machinery
- ii) Timely overhauling
- iii) Routine checking of machinery
- iv) Maximum availability of machinery
- v) To correct any unforeseen breakdown
- vi) To execute regular jobs efficiently and quickly

And this system should have following characteristics :

- i) Flexible and resilient

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Maintenance is the foundation over which the palace of higher productivity is built. This paper has been essentially prepared to suggest a viable maintenance system suitable for our present state of industry and highlight the other factors which vitally effects its performance. For example best workable maintenance system will be of no use if position of spares is poor or cadre is either inadequate or poor or communication/instructions are incomplete. Some one said that a workman would like to work instead of sitting idle if he is provided with proper tools and spares and has been properly briefed. This is true to a very large extent. Therefore it is not only system but its effective implementation that is to be aimed at.

- | | |
|--|---|
| ii) To offer guidance in future for better maintenance | i) Age of the equipment/ machinery. |
| iii) To provide better inter & intra departmental communication | ii) Financial constraints and budgeting |
| iv) Easy to understand and execute | iii) Replacement |
| v) Provide explicit directions | iv) An efficient scheme for training the cadre And its improved performance can be obtained by: |
| vi) Promote better motivation | i) Analysing various breakdowns |
| vii) Regulate spares position And its success will depend upon: | ii) By exchanging information between mills |
| i) Motivation of maintenance crew | iii) Continuous study of Engineering systems |
| ii) Management leadership & authority delegation | iv) By keeping abreast latest advances in Engineering & Technology. |
| iii) Availability of sufficient quality spares | |
| iv) Sufficient stock of spares | |
| v) An efficient maintenance workshop | |
| vi) Enlightened operation staff | |
| vii) Environmental and behavioural conditions And its efficiency will depend upon: | |

Having thus enumerated all the stresses and strains to which a maintenance system will be subjected to and the aims and desired qualities, it will be our endeavour in following pages to deal with

them at length followed by a conclusion at every step and to incorporate these conclusions into a viable maintenance system. As at this meeting we are all from Paper Mills, the case study followed in these pages will relate to Paper Mills. Let us start with the AIM:

Efficient maintenance of equipment and machinery:

It should be remembered that our maintenance is as bad as under-maintenance. Over-maintenance results in excessive cost of maintenance by way of spares, lubricants, man-hours spent, lesser availability of equipments, excessive loading of purchase department or workshop and increased inventories. It normally should provide for:

- i) Lubrication needs
- ii) Wear & tear of parts caused by motion, corrosion, & erosion
- iii) Minimum cost of maintenance
- iv) Maximum availability of equipment.
- v) Elimination of breakdowns.

Conclusion:

- i) All the above points should be catered for.

Timely Overhauling:

An equipment subjected to various strains during its running needs attention.

If this attention is not provided timely, it breaks-down resulting in:

- i) unexpected stoppage of equipment for a longer period

- ii) badly affecting sound parts
- iii) sudden requirement of work force and spares

Therefore timely overhauling of equipments will be a regular feature of any maintenance system. This can be achieved by:

1. Listing of total equipments, if necessary, codifying them for purpose of reference.
2. Drawing monthly/periodic overhauling schedules based on experience or history cards for equipments. This must be remembered that these schedules are not static formations, these may be corrected in line with experience being gathered on individual equipment and to meet special and peculiar situations and characteristics of an individual plant. It may be noted that rigid schedules are apt to result in wasteful manpower and materials but caution be exercised to avoid frequent changes in schedules.
3. by executing overhauling schedules:

This requires:

- i) Assessment of spare parts, time and manpower requirement
- ii) Timely procurement of spares
- iii) Fixing a time and date depending upon the availability of equipment.
- iv) Arranging suitable man-

power equipped with proper tools

- v) Providing capable supervision at the time of overhauling
- vi) Co-ordination with process /production department
- vii) Drawing of detailed schedule for the month
- viii) Execute overhauling of equipments so planned.

In case of equipments which are vital for production, the exact timing of overhauling will be decided as per convenience of process/production departments. It is but natural that such flexibility is built in our planned maintenance. It is evident that such overhauling of equipments is essentially of preventive nature.

Conclusion:

- i) Preventive maintenance schedules encompassing all the equipments in a section should be drawn for the whole year and should be available with the section in a proper bind.
- ii) Sectional head should be made responsible for their efficient & judicious implementation.
- iii) Sectional head should draw in consultation with Production Incharge for the section detailed schedule for the month at least a week in advance before the beginning of the month in a proper proforma "Advance scheduling

for the month". Copy of this schedule jointly signed by section heads for maintenance and production should be sent to management.

- v) Replacements/modifications or changes effected on the equipment at the time of overhauling must be recorded in a proper History cards.
- vi) At the time of taking an equipment for overhauling, the job card jointly signed by maintenance and production signifying their respective consents should be made and kept with the section. The job completed slip jointly signed by production/maintenance supervisors should be detached from performances of job card and sent to section head.

Routine checking :

All equipment apart from overhauling at finite intervals need close observation to check if running conditions have changed requiring some action such as :

- i) failure of oilseal resulting in hot running of bearing and ultimately failure.
- ii) failure of gland sealing water, resulting in loss of fluid and creating unsafe conditions for operation
- iii) Absence of lubricant
- iv) Loosening of foundation and other bolts
- v) Slippage of belts

vi) Wear & Tear of coupling bushes

vii) Sudden development of sound by the equipment and many others

This can be achieved by :

- i) Introduction of check list for shifts to be signed by Shift Supervisors and scrutinised by section head.
- ii) Introduction of inspection cards for individual equipments. These inspection cards are to be filled by the Supervisor concerned for the area. After the inspection, the next date of inspection will be given by him depending upon his conclusions based on the condition of the equipment.
- (iii) These cards then will be filled date-wise in monthly folders for inspection cards kept in section.
- iv) The Supervisor concerned will draw out the folder for the month and execute it.
- v) Based on inspection, if any corrective action is required, it will be taken by this Supervisor after consulting section head.

Such maintenance essentially is of predictive type.

Conclusion

- i) Check list for shift supervisors are to be made.
- ii) Inspection cards for individual equipments.
- iii) Folders for various months.
- iv) Any action, if required based on inspection should be

taken. If it requires down-time on equipment then job card as suggested earlier to be used.

Maximum availability of machinery

This is the main theme of any maintenance system. Here it should be noted that down-time on machineries which directly result in production loss had to be minimized and if required increased manpower may be used. Increased availability of equipment for process can also be obtained by installation of stand-by equipments. Feasibility and essentiality of these should be examined from process/maintenance (electrical/mechanical/civil) point of view.

This therefore requires:

- i) Least down-time of equipment
- ii) Judicious provision of stand-by equipments.

This can be achieved by:

- i) Segregating equipments vital for production.
- ii) Determining if any stand-by is necessary.
- iii) Forwarding the requirement in a *stand-by requirement proforma* to management. This proforma will be duly signed by process/mechanical/electrical/civil. It will be originated in section requiring it.

To correct any unforeseen breakdown:

Inspite of devising system for avoiding breakdown, due to various reasons such as human

behaviour, unforeseen wear & tear, poor quality of spares etc. various breakdowns do occur in the mills. An efficient maintenance keeps these to minimum. Sectional head should have at its disposal a gang of good workers who will attend to such breakdowns. These people are normally to be different from those attending scheduled overhauling or inspections or lubrication. Section head will be directly in command of operations during major breakdowns and breakdown proforma will be filled by section head detailing reasons for breakdowns and steps taken to avoid it in future and sent to management.

Conclusion

- i) A gang of good workers to attend breakdowns.
- ii) Breakdown proforma to be used.

To execute regular jobs efficiently and quickly

Apart from jobs already covered there are various jobs such as leakage of valves, hose pipe tightening etc. round the clock which need attention. These jobs are either of immediate nature, or to stop wasteful practice or to create safe working conditions or to avoid future breakdowns.

There are other jobs which require attention. Such jobs for a paper mill are adjustment of dandy; felt and roll changing; drives a doctor changing; grin-

ding of knives and rolls; periodic shuts and cleaning etc. This requires a suitable maintenance crew, day-to-day manpower and job planning.

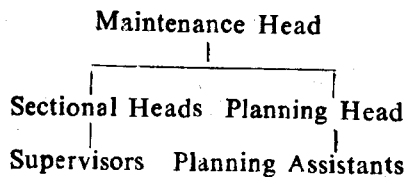
Conclusion:

- i) Suitable maintenance crew
- ii) A system of record keeping to suit individual organization such as Shift registers etc.
- iii) Use of job cards for such jobs.

Generally maintenance department is supposed to perform following five functions:

- i) Inspection:
Routine schedule checks of plant/building and equipment.
- ii) Engineering:
Preventive & corrective maintenance.
- iii) Production:
Repairing machine breakdowns.
- iv) Clerical:
Largely keeping record of costs, time progress on jobs and the like.
- v) House keeping :
Taking care of details of upkeep, cleaning of all buildings equipments, tools and plant facilities.

Keeping ourselves to the theme of the paper that is maintenance, structure as it emerges from above will be:



Now we shall dwell over the factors which will effect its success.

Motivation of maintenance crew:

This being a management function will not be dealt here but it will help if we enlighten each other with various methods being used by us. Security, salary, incentives and fairness of our judgements will be the key factors.

A poor productivity is the bane with which we are all saddled with. Output and quality of crew are the backbone of any maintenance system, otherwise however well designed and intentioned maintenance system be, it will fail. It will not be out of the place to mention that Maintenance is the backbone of industry.

We firmly believe that productivity in the organisation can be increased on continuous basis only if our employees are made aware of productivity concepts and techniques. It would therefore be necessary to conduct long training courses for managers, short courses for officers and office methods and procedure for our staff members and a continuous system for the training workmen. Thus we arrive at a very important conclusion.

Continuous training of Managers, Officers, Staff and Workers is a must for improved outputs.

An efficient maintenance workshop:

It will suffice to say that an efficient back-up workshop is the key of successful maintenance. An efficient workshop is the result of adoption of time tried workshop practices.

Workshop Incharge should project tentative requirement for the year well in advance so that materials are available in time. An efficient system of job allocation, follow-up, check-up and cost estimation may be established. Another important point would be communication between workshop and other maintenance sections.

This can be effectively achieved by:

- i) Using a job order card in quadruplicate, 3 copies sent to workshop.
- ii) Workshop will return third copy informing probable date for job to be ready.
- iii) Workshop will send 2nd copy to section after the job is completed.

In addition workshop will also get loaded with making of spares, meeting urgent demands caused by breakdowns, repairs of various parts and sometimes finishing of parts purchased from outside. The last mentioned becomes necessary as most of our machinery is imported and exact tolerances of various spare parts are not known and also because of wear and tear of mating part.

Enlightened operating staff

It is necessary to educate our thinking on this aspect. What we normally forget is that a man who runs the machine is as responsible as maintenance man for its efficient working.

The operating man is the first who by virtue of his constant association with equipment notes any difference in its behaviour and who will be the most happy man if equipment is operating on desired lines. Operating people should gladly co-operate with maintenance for giving an equipment for check up/overhauling/repairs. It should be noted that 50% of the maintenance done is to meet day-to-day process requirement. It will be a good idea to think over to adopt the practice which is followed abroad and in steel plants in India i.e., to keep such maintenance under production department. In that case capital maintenance only will be done by centralise system. We can pour our ideas and come to conclusions. Anyway one can start by associating shift maintenance with production department.

Environmental & behavioural conditions

All said and done maintenance efficiency as that of other departments will depend upon:

- i) Economic condition of country
- ii) Social and political movements

iii) Environmental condition viz, local leadership, cleanliness and safety consciousness, welfare and health schemes. One should remember that cleanliness inspires cleanliness which in turn is a sign of thoughtful and organised working. It is a vast subject. But this may be the single most important factor determining the efficient working of the department.

Having discussed the factors which determine its success, we shall now discuss points which will determine the efficiency of maintenance department.

Age of equipment/machinery

Older the machines increased will be the cost of maintenance, extra man-power requirement, excessive inventory cost etc. It may not be possible to procure spare or equipment locally at economic price for our imported plant, but under stringent foreign exchange position we have no alternative except to make them locally resulting in excessive cost and large time lag. It will be helpful if we exchange our information on location/development of such sources. Further it will be interesting to find a suitable relation between age of plant and maintenance cost.

Financial constraints & budgeting

It is our contention that sufficient funds should be made available to maintenance department to make it effective.

Happily authors, all from J.K. Paper Mills, are pleased to inform that we are following an effective system of budgeting maintenance requirement under following heads:

- a) Capital budget
- b) Revenue budget
- c) Contractors budget
- d. Consumables & other regular requirement
- e) Manpower requirement
- f) Import budget

In addition, we have successfully introduced inventory replacement policy in our mills. This has reduced indenting to considerable extent, has helped in reducing inventory cost and indicates points of over consumptions for effective control.

It will be helpful if informations are exchanged on the systems adopted for such budgetary controls by mills engaged in engaged in similar product manufacturing.

Here we may mention some of the practices being followed abroad. These seem logical and are paying dividends in form of better management, improved maintenance and healthy atmosphere prevailing in the organisation. We are all well aware that apart from periodic preventive maintenance and check ups all other jobs of maintenance are a result of process requirement for example (i) change of wire of various filters and washers, (ii) wire changes, (iii) felt changes, (iv) various roll changing sched-

ule, (v) boiler periodic cleaning, (vi) monthly shuts of recovery plants. (vii) periodic cleaning of Evaporators, pre-heaters, digesters and many others. The budgeting of manpower requirement for these is normally done by process. Such budgeting of manpower will take us a step towards more organised, better managed and improved working.

Replacement policy

Mr. Henry Ford once said 'If you needed a new machine and did not buy it, you paid for it. This still holds good. These replacements may be caused by deterioration, obsolescence, inadequacy, improved materials and poor economics.

As time passes operating inferiorities expressed in terms of money value gets larger as new machines/process etc. are placed in market. But new machines cost money and a manager is placed in a dilemma of choosing more capital and more perfection on one hand and less cost and more imperfection on the other. Therefore it is necessary to establish a well defined policy for it.

Replacement investments required by physical deterioration are not a problem of investment or on investment since the entire plant shutdown if the replacements were not made.

Functional obsolescence invalidates the deprecia schedule as functionally obsolescent piece

of equipment has little or no scrap value. In case of technological obsolescence, the economics of timing become important.

Management desires that the capital funds invested in an equipment must be recovered during its service life. Thus we see that the problems of analysing equipment needs require careful attention and this can not be, left to the judgement of the various supervisors and departmental heads who are responsible for the operation of the equipment as is done in most of the mills. Most of the supervisors are too busy with every day problems. Everybody's business is nobody's. If the management is to have intelligent and comprehensive programme for it then one individual in the company must be charged with the responsibility and management would know how much it was costing to replace as well as the probable economics that would result from replacing.

Under such a system suggestions from supervisors and departmental heads would now be routed through the individual specialist. The replacement specialist, of course, could also originate investigation on his own and would present the replacement analysis to management using latest techniques available (*MAPI* formulae etc.). This specialist be given a proper organizational frame work for

him to operate in as he should be aware of company's policies, plans for the future, proposed expansion projects and so on.

An efficient scheme for training the cadre :

The importance of training cannot be over-emphasized. Though discussions under this head normally would be in the realm of personnel management but it would be necessary here to emphasize that poor cadre is one of the basic reasons for poor maintenance. Another reason for dilution of the quality of workman is sudden expansion in a particular industry as it has happened in paper. As a result good people are lured away by new organisations weakening the cadre in existing mills and pushing the wages up in an effort to retain people. We must ponder over this subject very deeply and may evolve a conscious/united approach as was done by steel plants when faced with similar dilemma which basically amounts to obtaining a no objection certificate from its parent organization.

Further for improved performance of maintenance department following techniques may be made use of.

Analysis of various breakdowns :

As discussed earlier, in case of breakdown, a breakdown job card will be filled analysing the reasons for breakdown and steps suggested to prevent it in future and a follow-up slip which will

be filled on implementing the steps suggested and sent to management. Section incharge will study the history card before suggesting the steps to be implemented.

This requires :

- i) Breakdown job analysis card in triplicate First copy to be sent to management after the breakdown has occurred and repaired. Second copy to be sent to management after implementing the suggestions made.

By exchanging informations on maintenance aspect with other Mills :

The underlying idea is not far to seek. If a particular breakdown has occurred in a mill, other mills should derive necessary inferences from it and take preventive steps. Maintenance men from different mills in a particular industry should meet periodically say once in a year and exchange information on major breakdowns faced by them.

The other aspect which needs communication between mills is:

- i) the cost of maintenance/tonne of paper
- ii) procedure adopted for budgeting
- iii) cost of inventories expressed as percentage of turn over
- iv) location & sources for spares
- v) relation between maintenance cost and age of plant
- vi) repetitive jobs

By keeping abreast latest techniques :

Considerable savings can be effected and many burning problems solved by making use of such techniques :

- i) **Better materials :** which can withstand more severe conditions resulting in reduced maintenance.
- ii) **Pert analysis :** oil refiners have obtained spectacular results by making use of PERT techniques in maintenance. Essentially, it will be useful for Annual shutdowns or repetitive jobs viz , wire/felt changes etc.
- iii) **Value Engineering :** This technique was used very effectively in United States for reducing cost of product. Later it became a vogue in Western countries and found its use in various fields including maintenance. Essentially it asks one to analyse (i) if a part is really required, (ii) can it be replaced by simpler one, (iii) are the materials used for its construction essential for its working, (iv) can't it be replaced by cheaper materials.

Painting

This is one aspect which is very haphazardly attended to in various mills and due attention required is rarely paid to it. What one forgets is that once the rust or corrosion has set in any amount of superfluous painting is simply a waste.

In fact it is necessary that a comprehensive scheme for painting is prepared and executed thoroughly. It will be a round the year job for all years to come. Poor painting reduces life of equipment, effects its working and result in more maintenance and increased replacements etc.

Conclusion

Having discussed various aspects of maintenance management, it can be summarised that an effective system will make use of various proformas (Annexures I to X) and laydown well defined policies on various other matters viz. equipment replacement, authority delegation, procure-

ment, training, import substitution, standardisation etc. The communication between mills as suggested if implemented may help us in attaining very high standards of maintenance. A well laid system on above lines, the authors are sure, will result in considerable improved standards of maintenance.

Annex. I

Periodic/Monthly Maintenance Schedule

Deptt.....Section..... Month.....
Area.....

| Sl. no. | Equipment | Jobs to be Done | Schedule |
|---------|-----------|-----------------|----------|
|---------|-----------|-----------------|----------|

Annex. II

Check List

Deptt.....Section..... Date.....
Area..... Shift.....

| Sl. no. | Equipment | Jobs to be Done | Remarks |
|---------|-----------|-----------------|---------|
|---------|-----------|-----------------|---------|

Shift Supervisor

Maintenance I/O.

Annex. III

Job Card

Department.....Section..... Area

| | | |
|--|---------------|----------------------------|
| Job..... | Job Completed | Information to Elec./Mech. |
| Equipment ..... | ..... | Equipment..... |
| Start time..... | Time..... | ..... |
| Expected finish..... | Date..... | ..... |
| time..... | Equipment | Job start time..... |
| Alternative steps, if any, required..... | Commissioned | Expected completion time |
| | | |

Production Supervisor

Maintenance Supervisor

Maintenance Supervisor

Process Supervisor

Maintenance Supervisor

To be sent to Maint. I/c.

**In Quadruplicate
Annex. IV
Job Order Card**

To
Workshop
From:..... Date..... Sl. No.....
..... Department..... Area.....

| Sl. no. | Job | Drg. No. | No. Reqd. | When Reqd. | Remarks |
|---------|-----|----------|-----------|------------|---------|
|---------|-----|----------|-----------|------------|---------|

To be filled by Workshop :

A) Job order no. allocated Expected date of completion... ..
B) Job Ready : Time..... Date..... Stored at.....

Maintenance I/C.

Workshop I/C.

**Annex. V
Advance Intimation Form**

From :

To :

Date.....

Following jobs may please be attended for reasons indicated during the coming shut on.....

| Sl. No. | Equipment | Nature of Jobs To Be Done | Remarks |
|---------|-----------|---------------------------|---------|
|---------|-----------|---------------------------|---------|

Section Head (Process)

In triplicate

**Annex. VI
Breakdown Proforma**

Department.....
Area.....

Section.....

Date.....

| Details of Breakdown | Analysis of Breakdown | Preventive Action |
|----------------------|-----------------------|-------------------|
|----------------------|-----------------------|-------------------|

Preventive action taken: By.....

Date.. ..

Maintenance I/C

Annex. VII
Advance Scheduling for The Month

Department..... Section..... Month.....
Area..... Date

| Sl. No. | Equipment | Date | Time | | Remarks |
|------------|-----------|------|------|----|---------|
| | | | From | To | |

Maintenance I/C

cc to Maintenance I/c

cc to Production I/c

cc to Management

Production I/C

Note: To be prepared atleast a week in advance for ensuing month.

Annex. VIII

Standby Requirement Proforma

Date.....

- i) Organised by..... Department..... Section.....
- ii) Existing Equipment:
- a) Name
 - b) Location
 - c) Quantity
 - d) Specifications
- iii) Reasons for standby requirement
- iv) Proposed requirement:
- a) Main equipment
 - b) Quantity
 - c) Auxiliary requirement (Electrical & Civil)
 - d) Financial requirement:
 1. Equipment
 2. Auxiliaries
 3. Electrical & Civil
 4. Miscellaneous - e) Period:
 1. Erection
 2. Plant shut - f) Delivery required
- v) Justification:
1. Increase in efficiency
 2. Savings in plant down-time
 3. Others, if any

Scrutinised by

Planning I/C

Process I/C

Civil I/C

Maint. I/C
(Elec)

Maint I/C
(Mech)

Annex. IX

S. No.

J.K. Paper Mills

**Emblem
Spl**

**Inspection/P.M. Cards
(A. E. To Check)**

**Emblem
Jkpm**

Preventive Maint.

Year 1975-19

| | | |
|-------------------------------|--------------------------------|-------------------|
| Department..... | Sub. Part Specification | Sub. Drive |
| Section..... | ..... | ..... |
| Name of Equipment..... | ..... | ..... |
| Code No..... | ..... | ..... |
| Sub-Part..... | ..... | ..... |

| | | | | | | | | | | | | |
|-----------------------------|-------------------------|----------------------------|--------------------------------------|------------------------|------------------|------------------|-------------------|-------------------------|----------------------|--------------------------|----------------|--------------|
| Due Date of Checking | Date of Checking | Gland/Shaft Sleeves | Bearing & Its Lubrication | Couplings/Belts | Impellers | Oil Seals | Wear Faces | Foundation Bolts | Gland Sealing | Gland Lubrication | Remarks | Sign. |
| | | | | | | | | | | | | |

Opening Date.....Month : Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep.
Closing Date..... Oct. Nov. Dec.

M E/SR. M.E.

Note - After Its Completion, Return It to The Planning Cell

Emblem
Spl
Preventive Maint.
Year: 1975-19

Annex. X

J.K. Paper Mills
Equipment History Card

Emblem
Jkpm

| | | |
|--------------------------|---------------------|--------------------|
| Department:..... | Location..... | Specification..... |
| Section | From & To..... | (With Drive) |
| Name of Equipment: | Operating Cond..... | ..... |
| Code No..... | ..... | ..... |
| Quantity..... | ..... | ..... |

| Sl. No. | Nature of Jobs | Preventive Action Taken Proposed | Stoppage Due to | Remarks | Fitter | Sign |
|---------|----------------|----------------------------------|-----------------|---------|--------|------|
|---------|----------------|----------------------------------|-----------------|---------|--------|------|

| Symbol | *Breakdown Schedule Maint. | Month: Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sept. Oct. Nov. Dec. |
|--------|-------------------------------|--|
|--------|-------------------------------|--|

| Sl. No. | Spares | Drg. No. | Stock Position | Pending Order/P.R. | Supplier | Remarks |
|---------|--------|----------|----------------|--------------------|----------|---------|
|---------|--------|----------|----------------|--------------------|----------|---------|

Note:—After Its Completion Return It To The Planning Cell.

WHEN SMALL AND BIG PULP & PAPER MILLS
HAVE PROBLEMS THEY CALL

PAPERTECH CONSULTANTS

14-15 SHANKAR DHAM
157, SION-WADALA NORTH-EAST ROAD
BOMBAY-400031