THOUGHTS ON "R AND D" IN THE PULP AND PAPER INDUSTRY.

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Without quest for knowledge, there can be no progress. Hencewithout efforts being put into or one being inquisitive to find out how a particular parameter would affect a reaction or affect on the quality or quantity of a product, the advancement of knowledge cannot come about. As all of you are well aware of the proverbial saying "Necessity is the mother of invention" but having invented a particular thing, can one just sit back and relax? No. In fact more greater efforts have to be put in thereafter to see that the invention brought about is further improved or bettered. How does one go about doing this? This is where ingenuity or the inquisitiveness of the individual or a group comes into play, and this is where the effort called R & D ie Research and Development takes place. If, as I said earlier "Necessity is the mother of all inventions" then why not refinement brough about by Research and Development, the "children of invention"? As the English saying goes 'chip of the old block' or as in some other vernacular saying 'baap seer to

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*Keynote address delivered on March 19, 1977 at Mavlankar Hall, New Deihi.

beta sava seer'. It is essential that it is instilled in one and all, that without R and D efforts, whatever one has produced or any product would become stagnant or obsolete in its quality and in due course of time price itself out of the market. However, it is but human nature that he or she wants things better, if not cheaper all the time. Anything you look around today, you will find some improvement taken place and it is not just the same as what it was say a year or two, 5 or 10 years ago depending upon the product/item. In certain items like fast moving consumer goods the obsole eness is a matter of even few months. One can look at the electronics gadgets, watches, cameras, radios and so on. Even chemical processes become obsolete within a few years. What about the textile fabrics, fashions etc.? There is no end to the list. One would say that buildings are permanent and they do not become obsolete. But is it not true that newer buildings made of modern architectural designs are quite different from the old? Of course, some of the old buildings are kept for grandeur, but some may have to be demolished also because of new areas being developed since they would not conform or stand with the new environments.

So how do these changes come

about. There are thousands of people working in each field as what is known as R and D department to see what improvements can be done. There are few genius also who create a complete break-through in technology-whether it is chemical, metalurgical mechanical. or otherwise. This then becomes once again a starting point for further refinement on that and this process is never ending. No dout for transforming an initial idea to its commercial application, one says it takes 10 years on an average. But I would feel that this was so a few decades ago. Now with the availability of new gadgets, especially computers, it is possible to understand a lot of things/parameters in few hours or days (whereby lot of time is now saved) which otherwise earlier would have taken, months and years. Therefore, from a new idea to its commercial application, I would now think it should not take more than maximum 2-4 years and this delay also is on account of the time involved in the fabrication and/or erection of the equipment in case of new Plants or a few months if it is just the question of a change over an assembly line just like a new model car, radio, cameras, etc.

What does all this mean? It means catering to the likes of the

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common man-whether it is a consumable item or it is an industrial product, which ultimately goes to the consumer in one form or the other. Nodoubt, all these costs money and the fact remains that ultimately all these are paid by you and I-consumer in one form or the other, But without the original initiative or the perception of the ideas and its followthrough this would not come about. Therefore, money has to be allocated for this type of work.

Companies which spend money on R and D efforts, make out long and short term plans. Some ideas when translated into practical application can derive immediate benefits, while others such as fundamental research work etc. takes its own time for application and may take 5-10 years for returns. In any case what one works on today will yield benefits sooner or later depending upon the type of seed sown.

What we are presently concerned with is our industry i.e. Pulp and Paper. All of you are well aware of how the Paper industry commenced centuries ago in Egypt and China and also thereafter how the industrial revolution in late 19th century made it possibile for paper to be made by mechanical means and thereby it became available in greater quantities. During the 20th century world's total production has gone up leaps and bounds and now in the year '75 the world's total Paper and Paperboard production is in

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the region of 160 million tonnes annually. The extent of the rate of increase can be judged by the fact that even as late as 1960 the world's total production was only 75 million tonnes.

Process-wise also from the original soda to sulphate and on to kraft and also mechanical, semi-chemical, chemi-mechanical and thermomechanical have taken place. Do you think that these developments have come about just by doing nothing? Would you not agree that few people having been given the opportunity and also having had vision and urge to investigate or get deep into the problems were able to evolve new processes, equipment etc.? I have recently read that a country like Japan spends nearly 0.6-0.7% of their gross sales value of Paper and Paper board on R and D. A country like Canada also spends 0.3-04% of their gross sales value on R and D. This is comparatively quite a low figure since one would have thought that Canada would have spent more than at least Japan. The production of the paper and paperboard in Japan which was only in the order of 4.5 million tonnes in 1960 has increased tremendously and in the year 1974 it was 15.6 million tonnes-an increase of nearly more than 3.5 fold ! Assuming that the average sales value then of this paper and paperboard was about US Dollars 200 tonne, then the gross sales turnover would be about US \$ 3.2 billion or Rs. 2808: crores. As mentioned above, 0.6-0.7% of their gross sales value on R and D would

therefore, mean that annually nearly Rs. 16.8 to 19.7 crores would have been spent. In the same way Canada which was producing 7.8 million tonnes of paper and paper board in 1960, produced 13.22 million tonnes in 1974. However they produced more of market pulp than what was required, to be converted into paper and paperboard. For information in 1960 the total pulp produced by them was 11.00 million tonnes while in 1974 it was 19.2 million tonnes. Therefore based on the higher production of 19.2 million tonnes. assuming a realisation was then of the order of US \$ 175 tonnes on average, their gross sales value would then be US \$ 3.36 billion or in terms of Rs 3024 crores. As mentioned earlier their rate of investment on R and D being in the region of 0.3-0.4%, it would mean that they would be spending annually anywhere Rs. 9-12 crores.

Although no figures for USA are available, off hand, for as to how much they have been spending on R and D, but knowing that in 1974 its production of paper and paperboard was 55 million tonnes which is nearly 3.7 times that of Japan, and even if they had spent same percentage on R and D as that of Japan, it would mean that nearly Rs. 62-72 crores they would be spending annually. It goes without saying that most likely the percentage of amount spent USA on R and D would certainly be more than that of

Japan and hence the figure of Rs 62-72 crores taken would be more conservative.

All the above figures are based on 1974 statistics. You will no doubt agree that if the production rate of 1976 or 1977 are taken, their gross volume of production would have been still increased and thereby the money being spent on R and D would have also further increased proportionately. It, therefore, just goes to show what efforts are being made by these developed countries in trying to evolve new processes, new economics and new equipments to see that Pulp, Paper and Paperboard are produced of a better quality and at cheaper cost too and at the same time look into the conservation of raw materials also.

The financial analysis of 13 major paper and paperboard producing companies in India has been done which constitute 70% (550,000 tonnes) of the total production in our country. In 1973-74 the gross sales value of these companies production exclusive of excise duty was Rs. 147 The same companies crores. during 1974-75 had a gross sales of Rs. 217 crores, while in 1975/76 it was Rs. 185 crores. Although there are no available figures as to how much the Indian industry would have spent on R and D efforts, it is not likely to be more than few lakhs of rupees. This is mentioned since Govt. of India has already enacted a R and D incentive for

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tax benefits. But from the information received from Govt. been only officials, there has from thc negligible claims industries on this account. This is all the more strange since if R and D was being done, I am our industrialists would sure not have missed the chance of availing the tax benefits offered by the Government. Therefore, really speaking very little is being done in our country on the R and D front. On a percentage-wise, we may not be even spending in the region of 0.01%, which you all will agree is certainly deplorable. This therefore, is really the cause for introspection and to see that things are set right.

In a country like ours it is all the more necessary that R and D is given due importance since our requirements. raw materials, equipment, working habits are quite different from the other developed countries. We have to find out what is the best for us and get maximum out of our own raw materials, equipment and manpower. Just transplanting technology developed on other raw materials abroad to ours would not give the desired results. It is for this purpose that we must have a more vigorous drive on the R and D front, whether it is in private sector, public establishing or by sector institutions like FRI, IPT-Saharanpur, or NCL R and D does not mean limiting the activities to chemical processes or technology, but also it should

extended to machinery be development etc. Many must not be aware that Pulp and Paper Institute. Research Canada (PPRIC) is an institution where all sorts of research work are being carried i.e. both chemical, mechanical etc. In fact to their credit, goes the development of the twin-wire paper making machine viz. Papriformer which has now become very popular all over the world. PPRIC has patented the same and have assigned it to various machinery manufacturers. In this case, as you will notice, it is the idea of making paper on a twin-wire which has been translated into a commercial proposition. You should also be aware that there are now several other twin-wire formers besides the Papriformer. This then is refinement. All of you must be aware that in our country also there is a Papriformer machine which is working at West Coast Paper Mills, Dandeli.

An institution on the above lines as the Canadian one has already been mooted by the Govt. of India and in the inital stages i.e. last year there was very great enthusiasm, but it seems that this idea is bogged down due to some internal conflicts. This development is unfortunate. You would all agree that such an institution which was to be called "Pulp & Paper Research Institute of India" would have given an impetus to the R and D efforts in the country. It would certainly be to the great advantage of our country if it can be set up even now without

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any further loss of time. Of course there is the need of coordination between the existing institutions-whether they may be private or public, and the new venture, so that the efforts are directed in a systamatic manner with definite objective of goals in view which would go a long way. If we have to progress, we must make haste, but this does not mean that one should waste our energy in the wrong direction. We have the technical manpower second to none in the field and what is required is proper facilities and guidance.

The latest technical trends in the world in the process technology and R and D covering pulp manufacture and paper are in the following fields :

1. Delignification of wood

a) Kraft process continues to grow as a percentage of total chemical pulp produced. The intensive research is currently under way at quite few laboratories on the use of oxygen/alkali as delignification agent. The ultimate goal of this research should be the development of significantly higher yield pulping process, with minimum environmental impact and a significant reduction in capital cost.

b) Well automated continuous digestion is being applied increasingly except for the production of the speciality grades of pulp and it should be helpful in reducing the unit cost.

c) Higher yield kraft process

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modification (polysulphide and hydrogen sulphide) continues to command consideration, but return and investment and chemical recovery problems apparently have slowed down their adoption.

d) Research and Development efforts to reduce both operational hazards and capital intensity of increase in the current kraft recovery process may be important for the future, particularly if the current research fails to lead to a new and better delignification process.

2. Bleaching

In the pulp bleaching process changes centre on (i) addition of oxygen/alkali bleaching stages to a multi stage sequence to reduce the chemical costs and BOD load of effluent (ii) continuous high standard diffusion chemical reaction in washing thereby reducing chemical and fresh water consumption

Solvent pulping development such as with water ethanol mixture, appears to have been slowed down in USA, Canada, but it is reported that development is going on vigorously in Europe. The demand of the by-product of pulp and paper industry viz. Lignin because of the increased cost in the petro chemical industry has also gone up. It is mentioned that if this trend continues, there may be renewed interest in solvent pulping particularly if high solvent recovery could be demonstrated on a reasonable scale and if viscous liquor lignin material could be handled economically. Secondary fibre utilisation is

increasing world over. This is necessary from a point of view of, raw material conservation. However at the same time better equipment and process to handle contaminants such as pressure sensitive adhesives and economical systems to process and upgrade mixed waste paper are needed. The Research and Development of a total energy concept for utilising energy to the best extent of steam and power which could be generated from it is also being vigorously looked into. Looking, therefore, into the trends o' R and D in the immediate past as outlined above, it will have important part to play in the R and D of next decade. Other important technical needs can be enumerated as follows:

a) Energy conservation measures including important water removal and drying techiques.

b) Continuous reduction of water - usage and pollution.

c) Greater use of high yield pulp including thermo-mechanical pulp.

d) Greater use of secondary fibre selectively recovered with low pollution.

e) Control of noise.

f) Continuous on machine measurement of paper strength.

g) Low cost fibre forming bonding in dry form process.

h) Implementation of electrokinetic science in paper making.

One is already aware of the development that is going on to reduce or even eliminate the effluent coming from Pulp and Paper Mills. Last year we had

the pleasure of having Dr. W.H. Rapson to address our Annual General Meeting, who as you all know, is very actively involved in an effluent-free Mill which is being set up on Great Lakes, Canada. Last year he gave us the outline of this particular mill, and the latest information has been that the mill which is already in production is likely to commission their Salt Recovery system by the end of March/April, 1977. Once this is done, the performance of the mill will be observed very closely to see whether any effluent does come out or not. This indeed is a break-through in the abatement of effluent since if found satisfactory, am sure, as mentioned, further refinement can be done in order that greatest economy may be worked out in some section or the other in order to make the same process applicable to most of the mills world over. Just to recapitulate-the Mill will be using only 15 M³ of water/ tonne of paper, instead of the normally 150 M³ in Western countries. and 300 to 400 M³ in our country. Just imagine the saving that can accrue in treatment and energy !

What I have mentioned above are the trends which are prevalent in the rest of the world. We in India have to tackle our own problems. We have the problem of utilising unconventional raw materials such as bamboos, which is being used only to a small extent in rest of the world,

agricultural residues and mixed tropical hardwood. I would say that the development work on bamboo has been exhaustive in our country. But still I do not think we have got the best out of it. Lot of efforts have still to be put in to get higher yield, better strength, etc. by further process developments. Guidelines on how this can be achieved are a'ready available in similar working on other raw materials being carried out in other countries. As for agricultural residue we talk of straw and bagasse. These two raw materials are also found all over the world and lot of work has been done on it especially in Holland and UK for the Straw, and for bagasse in Cuba, USA and South America. Why is it not possible to coordinate our effots in this field and save valuable time and see that the latest work which has been carried out is made straightaway applicable in our country with local modifications and not to go through every step. As for tropical hardwood this is also n tsomething new, except for the fact that certain species that we have may not be available in tropical countries and other hence optimum parameters to the same have to be developed.

The utilisation of the raw materials to its maximum extent is very important. We have lately seen in the western world the concept of "whole-tree" utilisation gaining momentum. In fact equipment have been developed

for handling trees in its full length of 80'-200' or more even, and then delimbing them and making into chips. In fact no debarking is done. What they have thought is most economical, that if tree as such is made into chips, removal of barks and other extraneous material can be done through chip screening to a great degree and thereafter screening and centricleaning in the unbleached and bleached sequences. Therefore not a kg. of cellulosis material is left in the forest so that it may get wasted over there, while at the same time to see that it is utilised to the maximum extent by converting into Pulp and Paper.

Lately the question of utilising saw dust from wood by making it into market pulp has also gained momentum. For the information of all, Weyerhaeur, Canada has established a Pulp Mill which is located at Kamloops, B.C. which has a daily output of 1100 A.D. Metric tonne of market bleached kraft pulp out of which they are producing 250 tonnes/day of bleached Kraft market pulp from exclusively saw dust. The properties of this pulp compared to that of other soft woods and hardwoods, in burst, tear and breaking length is about 65-70%, but the fold strength is low. However, the beating time required to reach reasonable strength properties is much lower than the normal chip pulp. In an energy concious society this has a distinct advantage Additionally the brightness drop during

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beating is less than that of softwood. Kraft pulp, Bleached softwood sulfites and bleached hardwood show similar ٥r greater brightness drop during beating to that of softwood kraft. Sawdust pulp provides good surface smoothness and excellent dimentional stability. It will form a tight sheet free from pinholes. The use of saw dust pulp looking into it from the properties could be for :

- a) Photographic paper because of its surface smoothness.
- b) For glassine and grease-proof paper because of its smoothness and barrier properties.
- c) For uncoated printing papers where it would give better printing and smoothness.
- d) For copying papers and coated papers where it would provide good holdout properties.
- e) For wet web saturation and bleach boards where surface smoothness is important.

You will, therefore, see that the intitative or even to an extent of goading new, developments in any field and especially in our Fulp and Paper cannot come about without concerted efforts of R and D. More continued attempts and more money have to be diverted for this field. Further, this cannot be just a forceful diverson on the industry but there has to be an incentive.

I would like to pass on some of the information on some of the technical developments which are taking place in Japan and Sweden. In Japan the utilisation of TMP in various grades of papers is increasing as also for making newsprint out of 100% TMP. Japan also like Canada is trying to develop a pollution free pulping process, which they call "PFP" and the main point in it is to eliminate sulphur from the cooking chemicals. It is essentially holo pulping and delignifying the standard 3/4-1" chips by the sequence C-E-H-E-D-E-D. Cooking yield is 60% and the capital cost of this newly developed process is about 146% of a standard bleach kraft mill of the same capacity and its operating cost 135% of a standard mill. The increased cost is due to the increased energy cost on account of the oil crisis. If the yield is reduced to 50% then the capital cost gets reduced to 105% of a standard bleach kraft mill.

In Sweden, the country where TMP has been developed, there are further rapid developments taking place in the same. The idea is to see that the steam consumption is further reduced and make the process applicable to all types of wood. Where the resin content of wood is very high a process has been developed where the chip deresinification takes place by blowing for 72 hrs. warm moist air through chip silos containing these chips. Some fresh air is also to be added to get the desired oxidisation of pitch. The maximum temperature reached during the above is 60°C e.g. a silo for a 60,000

tonnes/year sulphite mill is of about 35 M ht. and 20 M. dia. and uses about 1.7 tonnes of steam 60 psi_{k}/hr . The advantage of this system is of course that, for a given low pitch content in pulp it reduces inventory of logs that has to be held in storage. Better refining systems have been proclaimed by M/s. Defiberators for TMP called 'DIF' which is essentially a thermo-mechanical system without a pressurised presteamer. This system also facilitates better heat recovery.

High consistency pulp handling at 34-40% from washing process have been developed recently. It helps in closed white water system and reduced chemical consumption. It also saves lot of erergy since that much of steam is less required to heat pulp. This high consistency pulp system is also essential for oxygen bleaching. From a pollution point of view. Ms. Uddeholms in Sweden have developed a closed bleach plant system using Resin-bed exchange for colour removal. system Extraction stage liquors from a multistage bleach plant are passed through the resin-bed exchange. It takes away about 90% of the colour, 80% of COD and 50% of BOD. Scrubber system atter precipitator electrostatic for removal of fine dust is still more in use and ensures more efficient dust removal if one section of the precipitator goes down and at the same time recovers substantial amount of heat. This type of scrubbers are getting to be more popular since air pollution

control is getting to be equally stringent compared to the water pollution.

The developments are not only limited to the Process side but also for maintenance too. Everyone knows that there are noises around, which means trouble. To detect any damage to a bearing with a wooden listening rod needs plenty of practice and provides no way to record the noise level for any future comparison. In Sweden what is known as "MEPA" shock pulse meter has been developed and marketed by SKF to overcome these disadvantages. Shock pulses i.e. vibrations with frequencies over 40 KHZ-do not usually spread far from their source and hence the Shock Pulp Sensors positioned close to the load zone of one bearing are not usually interfered with vibrations from the others. If the shock pulses of bearings are recorded when it is first put into service and monitored continuously thereafter it is easy to tell when the bearing becomes damaged and to take timely action. For information practically all new paper machines in Sweden are now being equipped with the Shock Pulse sensors and the results it is understood have been very favourable.

What has been mentioned earlier is what is going on to some degree in the rest of the world. This does not mean that this is the end to it-lot of work is also being carried out in USA, South America, Europe, USSR and

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other countries. It is easy to come to know what is going on in the various fields since technical publications or journals regularly report lot of these news as also in seminars. In our country, unfortnately except for the IPPTA magazine and to some degree 'Indian Forester' there is no other source from where one comes to know what developments are taking place in the country. If we go through our IPPTA magazine we find that original work or even development work is reported only very rarely. This does not mean, I would say, that no work is going on in our various industries in imploving their performance. But what is meant is that there is no exchange of information as to what is going on. If a regular rapport is possible, would you not agree that one would save lot of time and energy which one has to otherwise incur in solving their problems, ? I would therefore, urge that if the managements of various companies could open their heart out and let the technicians report of what is taking place in their Units or how they are solving their problem, or explain what steps they have taken to help solve the problems, it would go a long way in getting our industry on a more firmer footing, especially considering the fact that today paper industry is facing a buyers' market, wherein without superior quality and proper economics no mills can survive.

Please do not be under the impression that the Indian industry docs not believe in R and D. It does believe in it, but probably it does not know how to go about doing things. We have to the credit of the Indian industry, as personally known to me, the development of the rayongrade pulp using indigenous raw materials i.e. bamboos for the first time in the world. In fact further development work in this field have also taken place in the utilisation of eucalyptus wood also for making not only normal grade of Rayongrade pulp but for better quality such as for Filament and even Tyre cord. Subsequent work has also taken place wherein it has been proved that mixed tropical hardwoods, which hitherto was thought to be only good for ordinary staple fibre, can be successfully converted for pulp suitable for the production of Filament Rayon as well as Polynosic fibre and ultimately who knows for the Tyre cord also. This I may inform you that even Scientists of the developed countries were very doubtful. I am bringing this point out in order to show once again that our technical manpower including both technologists and scientists are second to none if given an opportunity and incentives.

Many a time one feels that Mills abroad are very big and whether such type of economics could be translated in our country. Many a times I have worked out the capital investment cost of Mills compared to the sizes abroad against what could be put up in Incia and found surprisingly that in our country even a 150 tonnes/ day Paper Mill could be economical because of our other special environmental conditions. Such 150 tpd Mill abroad would be unheard of.

All of you are well aware that for the last several years we have been talking of Mini Paper Plants of 10-30 tpd capacity, while in other countries small units have been closed down for decades unless they are producing very special grade final products. You may not believe also that a 100 to 200 tpd plant is rather considered to be small in other countries and they are being scrapped.

To conclude, I would like to once again state that efforts on the R and D in the pulp and paper industry is very much lacking as of today and it should be encouraged by all means. The Govt. has already given some tax benefits, beside this, some other incentives like ad hoc grant to initially start work in various industries could also be considered. The research and development work which is being carried out in the various industries could either be pooled together or at least if information on developments is passed through technical

journals it would be beneficial to technologists to understand what is going on elsewhere and avoid duplication of sesearch and wastage of time.

Our country though not completely, but to a great extent, is frought with her own problems on the pulp and paper field because of the peculiar raw materials and its disadvantages. We have to see that our processes are developed taking into consideration the end use of the product and not just making a chemical pulp with loss of yield for using the products which may range from rough paper to the best quality one. Japan has been making use of hardwoods 50 to 100% to manufacture paper. This all depends on what end use a particular paper is meant for. Why such a thing cannot be developed and put to use in our country? I also feel that the development of market pulp mills for producing chemical and mechanical pulp from both coniferous wood as well as hardwood should be taken up and made available to the industry. Even TMP pulp should by made from both the above raw materials. Even consideration could be given to making bagasse market pulp. By this means when such pulp is made available, the manufacturer can blend the various market pulps in the right proporation according to the requirement and thereby make a product at the most economical cost.

This in turn also would help spread out the various paper units all over the country towards the consumer centres. By setting up of such units, it would not only cost less but also since no pulping is involved at all, the effluent or the pollution problem is also nil. I personally think Indian mills should start utlizing chlorine dioxide as a bleaching step also since it would help not only to get a brighter pulp and thereby paper, but also from strength and quality point of view. Later on as seen from the development in the world, an effluent free unit based on chlorine dioxide or even to start off with a less obnoxious effluent discharge could be had when using chlorine dioxide than without it.

Let us, therefore, consider all the above points in the right perspective and take steps which will help develop our pulp and paper industry, which presently if compared to world's production is an infant, especially in comparison with our population and the raw material availability.