CHAPTER IX
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JUTE BAGS PACKAGING - A PROBLEM

(a) INTRODUCTION

In this economic march forward, the science and technology of packaging has played no small a role. It should be realised that the vast resources and high technology employed in this industry which is basically meant to promote human welfare, can and has interfered in man's healthy environment and has brought human misery, discomfort and loss to the consumer through outdated packaging employed by this industry for ages. It is high time that the merit with cost effectiveness should be the only criterion in selecting the mode of packaging.

Packaging is a link between the production and consumption and therefore the selection must necessarily consider protection of A) Consumer, B) People handling the material right from a packing machine till the final mason or worker at the point of consumption. I
personally feel, till recently, these two groups were totally neglected in the selection of packaging. The consumer must get the perfect quantity and quality of the material and people handling it from the packing machine till final consuming point should not be affected from the point of view of health and environment.

If India has produced an average of 60 million tonnes of cement, i.e. 300 million in the last five years with the conventional packing where the average loss of cement is 2.40 million tonnes, the loss of 2.4 million tonnes of cement worth Rs.600 Crores, has been eaten away by human bodies spoiling their health, and all that loss is that of the consumer.

Traditionally cement has been packed in India in Jute bags. Specifications for these jute bags were the sole packaging medium available for consumers in India. The specification for the jute cement bags laid down was based upon the following criteria:

i) Strength of bag
ii) Ability for handling
iii) Cover Factor  
iv) Re-uses  
v) Resistance to Hooking

Since plenty of jute was available in the country, no limitations were placed upon raw material contents. When sufficient quantities of jute bags at reasonable prices were available, only new first hand bags were used for packing cement. These bags were found quite acceptable and convenient. Being spowdery material, there was some amount of seepage but this was negligible and in many cases, after packing the infiltration of cement from the bag into the process acted as cover factor to prevent seepage.

When production and distribution of cement was controlled and entire production was levy cement, in the price structure of cement while BICP laid down the pricing formula for the cement material, the pricing formula for packing was fixed by the Industry Ministry every quarter.

Jute goods being an agriculture based produce, were subjected to fluctuations due to the supply and
price of raw material and consequently there were fluctuations in the price of finished goods. Whenever the packing material prices tended to rise, the policy adopted in fixing the packing charges was to use a part of the requirement in the form of second-hand bags and this was permitted mainly from the point of view of holding the line of the packing cost provided in the quarterly packing charge fixation. When prices tended to be very high, correspondingly the proportion of second-hand bags usage was also prescribed high. This practice led to a substantial portion of cement being packed into second-hand bags which did not burstage as a new bag.

When jute goods prices went to abnormally high levels during the year 1984-85 a new factor emerged where old second-hand bags were opened, reversed and restitched and supplied as new bags. This phenomena together with the use of second-hand bags led to a major portion of packing being done in sub-standard bags, which lead to heavy seepage and burstage losses.

Sometime in the year 1983, NCB, as measure of improving the quality of bags, changed the specification
to 8 x 10. This was done by maintaining the warp count and the weft count at the same levels but increasing one extra shedding and also increasing the bag weight. Theoretically, this measure was very positive and this led to increase in cover factor in 100% jute bags. If the usage of cement bags were restricted to all new bags of 8 x 10 construction, the consumer would not have any complaint at any point of time. But the phenomena of using second-hand bags and reconstructed bags in large quantities from time to time led to the jute packing being considered as a messy one and unsuitable, leading to losses of cement in handling and creating a consumer dislike to the entire family of jute bags.

The abnormal price rise of jute goods in the year 1984-85 was also partly created by shortage of supplies. Cement industry had to seek permission from the Government to go to alternative packaging materials and ISI permitted packing of cement in jute bags, synthetic bags, paper bags and any other type of bags as may be approved by the ISI. The very high price for the jute bags plus the above concessions opened the floodgates for creation of capacity to produce.
alternate types of packing materials. The principal growth in this respect was in the case of woven HDPE bags. The margin between the cost price and sale price was so large for these bags that it attracted large number of investors and capacity was sanctioned and created which was not only adequate to provide a supply equal to but almost double of what the jute industry was capable of giving.

The entire research and development that has been done in finding out suitable jute based bags for packing cement is to ensure that the type of bags provided will have lesser jute content so that more bags may be supplied by the industry with the available crop of jute. Simultaneously efforts have also been made for increasing the jute yield. In the year 1985-86, there has been a 25% increase in the yield of jute. In other words, with the growth in the yield and the reduction in the jute content in the new types of bags, the problem of raw jute shortage standing in the way of adequate supply of jute based bags to cement industry has been fully met.
DEMERITS OF JUTE BAGS

(1) The greatest drawbacks in Jute Bags is that there is no saving in seepage. Still Cement Bags are labeled as "50 Kgs. When Packed". This is renouncing all responsibilities for loss by seepage. However the end user is always at a loss. The National loss due to seepage is placed at Rs.600 Crores from Cement. This is being borne to protect Jute Industry and to and extent the reluctance on the part of users to change to a new made of packing. We trust, our economy can not afford this luxury of wastage.

(2) Adulteration can not be prevented in Jute Bags.

(3) Jute bags when used as packing made does not ensures manufacture of products to a fresh quality of packaging.

(4) Storage of Cement in Jute Bags is greed problem in moist conditions.
(5) Jute, which is an agricultural product leaves plenty on climatic conditions, rainfall and acreage which changes from season to season. This uncertainty leads to unreasonably high inventories.

(6) Jute Bags are no economical with respect to the other competing varieties in the market.

(7) **Appearance and Printing**: Appearance of the PP Bags is attractive and also the printing is shown up better than on a Jute bag. The appearance of printing is retained ever after filing the Cement, Unlive Jute Bags.

(8) Jute Bags are heavy in weight. The Transportation cost of these bags is very high and more bags cannot be transported in a single truck.
(b) VARIOUS TYPES OF JUTE BAGS

(1) Woven Varieties:— Before 1982, heavy cee bags used for packing cement were of 515 g weight and 8x9 construction. Use of second-hand bags were also permitted upto 40% depending upon the price structure. Seepage loss of 4% and above was reported. Consequently, at the instance of the Government and the industry, and R&D project was undertaken by NCB to develop improved variety of heavy cee bags. Preliminary investigations showed that seepage could be reduced by closer weaving of heavy cee fabric. Thus in close co-ordination with IJMA, five different varieties of bags were developed and tried in Laboratory and on large scale in Five Cement Plant. Although all the varieties of heavy cee bags gave better performance with respect to then conventional bags, CRI improved Heavy Cee Bags (8x10, 538) were more acceptable to the Jute Industry. Subsequently these bags were introduced by the Government for packing Cement in 1982. Indian Standard was modified (IS:2580-1982) to include the specification of CRI Improved Heavy Cee Bags.
In the Year 1984-85 steep escalation in the packing charges was witnessed by the Cement Industry. In a span of just 14 months the packing charges went up by nearly 84%. This was primarily due to growing Cement production on the one hand shortage in the supply of Jute bags in the market on the other. An urgent need was expressed both by the Industry and the Government to develop alternate varieties of jute bags which will reduce jute consumption as well as cost.

R&D studies are carried out by NCB in Co-ordination with IJMA and Cement Industry. The preliminary investigations showed that the requirement of jute in cement bags can be reduced in two ways, without adversely affecting their performance, namely (a) making a fabric, partially replacing Jute by HDPE (b) reducing the count of Jute Yarn. Accordingly the following varieties were developed:

i) Twelve different varieties of Jute Synthetic Union Bags;

ii) One Variety of Light Weight Jute Bag which
was an improved version of earlier CRI developed light weight bag successfully tried at the cement plants level. The improvement in the design was done with a view to use wider varieties of jute available in the market for making these bags.

Based on the results of laboratory evaluation, merits of large scale manufacture and economic considerations, six varieties of jute synthetic union bags and one variety of light weight jute bags were chosen for large scale plant trials (25,000 bags of each variety) in the following two plants:

i) Kesoram Cement Ltd., Basantnagar;

ii) Cement Corporation of India, Charkhi Dadri.

The following two varieties gave the best performance conforming to the requirements.

(a) NCB Light Weight Jute Bags 
(8x10, 446) - Type E-10.

(b) NCB Jute Synthetic Union Bags 
(8x10, 416) - Type E-6.

These bags had been introduced by the Government of India for packing cement since May 1986.
(2) Composite Varieties: It is possible to make Cement Bags from composite materials in which jute fabric forms a base to give the required strength properties along with other materials such as Jute, Paper or Synthetic sheets with or without bounding materials to improve performance characteristics such as resistance to see-page, moisture ingress, and packing temperature. Certain varieties could be eventually hooked also.

One such variety developed by NCB namely CRI DH Type bags have been successfully tested in Laboratory, on Large Scale in Cement Plants and at consumers' level. Performance of these bags as illustrated in Table. In the year 1976, export consignment of 40,000 Tonnes of Cement packed in these bags was sent to one of the middle-east Countries. Excellent feed-back reports are received ONGC has used these bags for packing oil well cement. All Indian Standards on ordinary and special cements recommend these bags for packing purpose. While developing composite bags special attention need to be paid towards Manufacturing Technology and cost aspects. Further R & D studies in this area are continuing in NCB.
CONCLUSION

Requirements of Jute in Cement Bags can be reduced by suitably blending the Jute with Synthetics in the Weaving Patterns. Large Scale Plant evaluations have shown that performance of such bags can be maintained at the required level. These lighter varieties improve the productivity of Jute Mills and give saving in packaging cost, and freight (due to Lower Weight). The work carried out by the NCB in the area is a beginning of R&D studies in this direction. In the area of composite bags further studies need to be carried out particularly in view of their improved performance.

Now we will come to consider the specific new types of bags that have been developed, their merits.

(3) 446 Cms. Light Weight All Jute Bags

Basically the construction of this bag is the same as that in the case of conventional 531 Cms. Bags but for the use of lighter warp with Superior Jute and Lighter Weft which is slack twisted. Because of the
better quality of Jute, breaking strength aspect is fully taken care of in the warp and because of slack twisting, with proper calendering, the cover factor is also achieved similar to the heavier weft used in the conventional bag. So, performance of these bags will be identical to that of 531 gms. bags.

The overall advantage of using this bag is that the Jute content has been reduced by about 16% which is a desirable step in the light of ability to produce larger number of bags with the available quantity of Jute Fibers. These bags can be utilised for packing cement hot as in the case of 531 gms. bag. Trials done by NCB have proved that the performance of these bags are satisfactory. The use of these bags has been cleared by the authorities for the packing of Cement and the feedback from the Cement Industry after using these bags is awaited. If there are any practical problems in the use of these bags on actual field trials, these can be adequately met by proper interaction between the Jute Industry, NCB and CMA.
(4) 416 Gms. Poly-Jute Bags

The basis on which these bags were developed was to go to a combination of Synthetic tapes and Jute Yarn in producing a mixed bag. It is felt that the direction in which produce diversification has to take place in the Jute Industry in order to satisfy all the needs of the end users is in the form of mixed bags. This matches with the logic behind going to the Terycotton material in preference to either cotton or terelene. Synthetic tapes are used in the warp for replacing 50% of the warp threads. In the normal 8 x 10 construction, there are 17 warp threads of jute yarn per inch. These are replaced with 9 threads of Jute Warp and 4 tapes placed alternatively side by side the warp way. Weft is from the same sacking weft system but slightly lighter. With a combination of tape and Jute in the warp, a lighter weft can give a very good cover factor. As a result of this combination, it has been possible to replace 2 jute warp threads in the alternate position with one tape and thereby the overall weight has been reduced from 531 gms. to 416 gms. making a saving of 22% by consumers that the cover factor provided by poly-
jute bag is superior to that of 531 gms. bag and also to the 446 gms. bag in as much as the flat tapes are able to give a larger coverage. Cement can be packing hot in these bags and bags do not slip. They are also capable of withstanding hooking due to the presence of the mesh of Jute in the warp partly and jute in the weft. I have dealt in greater detail on the aspect of hooking later. Strictly hooking resistance should not form a criteria in deciding the suitability of the bag.

(5) Poly-Jute Tubular Bags:

The poly-jute bag referred to above can be termed as the first generation bags. The ultimate in poly-jute bag will be to have a tubular construction made on a circular loom with PP tape in the warp and Jute Weft. In the warp we should have 11 PP tapes of 2.5 mm width which gives a cover factor of 2.75 cms. per inch. As one inch equals 2.5 cms. this will mean a 100% cover factor. The weft will be 16 Lbs Hessian Warp and there will be 10 weft threads per inch. Circular looms have
been developed in Taiwan which are capable of insertion of $120 \times 4 = 480$ threads per inch which at an efficiency of even 60% will be able to produce about 28.8" of tube per minute. On this basis, these looms are capable of producing 1,200 Cement Bags per loom per day of 23.5 hrs. With the utilisation of these looms, with PP tape in the warp and Jute Yarn in the weft, the tubular gazetted construction of Cement bags will be exactly similar to synthetic bags. These bags will have the added advantages as follows:

(1) Cement can be packed hot as PP has high melting point temperature.

(2) Nozzle will not slip as the combination of jute with synthetics gives a rough cloth.

(3) The bag surface is suitable for pelleting and making high piles without any slippage.

(4) The bags are provided with dog ears. These bags can be handled without using hooks.

(5) Seepage resistance is superior to Synthetic HDP Woven Bags.
With suitable assistance from the government in procuring PP Tapes, these bags can be made at prices which can match with Synthetics, delivered freight and duty paid to the Consumer. The content of jute per bag will be only 180 gms. as against 531 gms. in the conventional cement bags. Thus, the saving will be of the order of almost 66% in the jute content. In other words, with the same available quantity of jute, three times the number of bags can be made which can completely meet the apprehensions of inadequacy of Raw Jute Fiber to meet the requirement of bags for Cement Industry. The final bags will be by weight almost 80% Jute and will be a Jute product.

The Jute Yarn Spinning capacity required will be only 50% of that needed for the conventional bags. The installed machinery capacity of Jute Industry for making yarn can produce almost double the number of bags as they are producing today without any further investment. Thus, from the supply point of view, both from raw material angle and conversion machinery angle, needs are fully met. There will be full facility available to produce to produce the required number of bags.
In terms of quality, the tubular poly-jute bags will be superior to the 100% HDP Woven bags, as listed below:

1. The Cement can be packed hot directly without any cooling.
2. The operator can handle the bag safely as in the case of the 531 gms. all Jute Bags.
3. The valves can adhere well to the nozzle without slippage.
4. The bags will fill easily and properly.
5. There will be no slippage in stacking and handling.
6. The bags are practically seepage free as the warp laid out gives full cover and the weft build up gives very good anchorage.
7. Freight element will be only 1/3rd of that for conventional bags.
(8) Printing with printing ink will give very good get up and 100% look. In fact all internationally made P/P Bags are made to look like Jute. Here that finish is naturally obtained.

(9) The bags will be provided with dog ears for handling.

(c) **DRAWBACKS IN OTHER SHORTS OF PACKAGINGS**

**HDPE/PP BAGS**

Certain disadvantages of HDPE Bags have come in way of total acceptance of the same for packing cement, which are detailed below:

(1) With the concept of One Million Tonnes Capacity Cement Plants, speed of packing cement is becoming higher whereby a speed of 30 bags per minute per machine is necessary to achieve 100% production target. With the HDPE Bags, it has not been possible to improve the speed beyond 20 Bags per
minute per machine. This is because of tendency of HDPE bags to slip out of the spout by reason of its smoothness and thinness. It is necessary therefore to develop a device to improve the grip of the bag holding clamp.

(2) By and Large Cement is being packed in high temperature conditions ranging from 60 to 75°C and thermal conductivity of HDPE material being high, the filled bag gets very hot making it difficult for labour to handle with bare hands. This problem can be overcome by usage of gloves of proper material and type.

(3) Unlike Jute Bags HDPE Bags does not take much of stress while on movement through conveyers and chutes. Hence it will be necessary for the Cement Units to improve the handling system such that sharp edges are not present in the chutes. It is also necessary to properly maintain the handling system to prevent wastage of Bags, and Cement.
(4) HDPE Bags do not allow usage of hooks while handling the bags whereas the Industry is very much used to handle with hooks. No solution has been found to overcome this problem.

(5) Cost factor is a major deterrent and from the consumers' angle the resale value of empty bags is practically nil.

(6) There is feeling that HDPE / Synthetic Bags are disturbing the future of Jute Industry.

**PAPER BAGS:**

(1) The disadvantage of papers stems mainly from high percentage of bursting and its price also weight it down in competition.

(2) It is not economical due to the acute shortage of crimped craft paper in the Country.

(3) Paper Bag suppliers has to depend entirely on foreign source for crimped craft paper of right quality.
(d) BEST PACKAGING FOR CEMENT

In the present circumstances following types of Bags have been treated as a Best Packaging for Cement.

SYNTHETIC WOVEN BAGS (PLAIN HDPE/PP WOVEN BAGS)

In the early days when cement was not being manufactured in India, it was imported, such imported cement used to come in wooden kgs. secondly, when cement was manufactured for the first time in India, it was packed in Jute Bags. Jute bags were found to be the most economical and available packaging material for cement at that time. The cost of packing 50 kgs. cement was Rs.4/- Per Bag. Therefore, even if there was some loss during handling operations between the point of packaging and the point of consumption, nobody bothered or took a serious note of the same.

From time immemorial, jute bags had been the most popular packing media for cement, mainly due to its availability and versatility. Over the years its usage was firmly established despite its various shortcomings.
Attempts for an alternative packaging was not made all these years as the demand for jute bags being much lower than the supply. With the green revolution in the country and rapid growth in fertiliser and cement production, competition in the market as well as lesser availability of jute bags fastened the development of alternatives. Secondly the vagaries monsoon affected the jute production in the country and years of surplus were followed by years of shortages.

Till 1981-82, Cement was in short supply. Therefore, the customer was not choosy about the packaging of cement and meekly accepted cement which was packed even in old, used and secondhand Gunny Bags.

This scenario changed in 1985, and as there was tremendous shortage of jute bags for packaging of cement in the country, the prices of these jute bags skyrocketed. It is said that these bags were sold to the cement units even at Rs. 9/- per bag, which appeared to be exorbitant to the Cement Industry. Therefore, the new upcoming Cement Plants, specially in Southern Area, decided to try synthetic woven bags for packaging of
Cement. Along with this, some plants in the Western Area started using multiwalled draft paper bags for packaging of cement. These new types of packagings enabled both the cement plants as well as the consumer to evaluate all types of packaging materials. In this context, the introduction of synthetic bags, mainly in the field of cement packing is a major development. It was by trial and error. HDPE bags were found to have the following advantages over the Jute Bags. Therefore, Economic considerations also played a major part in overall acceptance of Synthetic Bags for Packing of Cement:

1. Seepage in Jute Bag can go up to 5% which makes wastage and seepage loss to the extent of 2.5 kg. per bag. HDPE bag being woven by flat tapes, reduces the number of pores in the fabric to have minimum and thus seepage loss has been limited to 1% which results in major saving of cement.

2. HDPE bags basically are stronger and it is seen that a 80 gms bag can match the strength of a 530 gms jute bag. Being lighter, the transportation
cost of HDPE bags is very low and more bags can be transported in a single truck. Further as a bale of 500 HDPE bags weigh only 40-45 kg, manual handling of the bale is much simpler.

(3) Pilferage — As compared to Jute bags, the chances of pilferage in HDPE bags are minimal as any sharp edged instrument damages the bag.

(4) Appearance and printing: Appearance of the HDPE bag is attractive since they are colored and also the printing is shown up better than on a Jute bag. The seepage being less, the appearance of printing is retained even after filling the cement, unlike jute bags. Recently the usage of pigments in HDPE bags has made it possible to supply coloured bags, which again is advantageous in marketing.

(5) Storage: In a given space more number of HDPE bags can be stored when compared to Jute Bags thereby increasing the utilisation of storage space to maximum.
(6) Unlike Jute Bags, HDPE Bags provide better protection from atmospheric conditions.

(7) After emptying the Cement, the Bag can be washed and utilised in number of ways and hence its resale value is also attractive.

(8) PP Woven Sacks are much cheaper than Jute Bags. The present price of standard 50 kg. capacity PP sack is Rs.6.50 when compared to Rs.13.50 per Jute bag.

(9) PP Woven Sacks are easily available in the Country and their supply is regular unlike Jute Bags.

(10) PP Woven Sacks have better resistance against insects when compared to Jute Bags.

(11) These bags have a tendency to withstand moisture much better in comparison to Jute bags and multi-walled kraft paper bags.
(12) Cement packed in synthetic woven bags remained in much better condition vis-a-vis packed in other packaging materials.

(13) Synthetic woven bags were found to be cheaper than jute bags, as well as multi-walled kraft paper bags.

The plastic Woven Sack was first introduced in India in the Year 1969. The Indian Industry was depending heavily on Jute Bags for its packaging needs when the Jute Crip failed in the years 1974 and 1979. Hit hard by the Jute bags shortages, the Indian Fertilizer Industry was the first to shift over to the Plastic Woven Sacks Packaging. The Cement Industry was the second to adopt Plastic Woven Sacks in India for packaging when the Jute Crip again failed in 1984 and created huge shortages of Jute Bags. In 1985 the Government of India realising great potential for Plastic Woven Sacks encouraged Plastic Woven Sacks manufacturing units which invested approximately Rs.500/- Crores through its financial institutions in promoting the Industry.
In the beginning, when the synthetic bags were introduced for packaging of Cement, the same were manufactured from a fabric woven on ordinary flat-bed shuttle looms, and manufactured exactly in the same way as jute bags are being manufactured, i.e. with 'U' stitching and side valves. Subsequently, when circular looms came into existence, these synthetic bags have been made from tubular woven fabric, weightless any side seam, having a paper bag type valve at 45 angle at the top. Such bags proved to be stronger than the earlier counterpart made on flat-bed looms.

Synthetic Woven bags can be manufactured from two types of Raw Materials:

**HIGH DENSITY POLYETHYLENE (HDPE)**

Bags which are manufactured from HDPE can withstand temperature upto 85 without any problems. Secondly, HDPE, is more stable when exposed to sunlight and does not deteriorate even when exposed to direct sunlight for continuous period of 3 months. Therefore, when woven bags are made from HDPE, the same need not have...
additives for making it light-stabilized. HDPE is smoother, and as such the printing on HDPE bags cannot be scratch-proof. Again, HDPE Woven bags are smoother in feel and as such have an increased tendency of slippage in comparison to PP Woven Bags.

In both the bags, there is no appreciable change in tenacity, denier and other physical characteristics. Therefore, for the given test values, normally both the bags will have the same weight and test results.

Many cases have been reported where complaints have been made regarding slippage of HDPE Woven Bags from nozzles of the Cement Packers. These complaints are easily removed by adjusting the packer nozzle and gripper of the packing machine. Addition of Jute Fabric / Kraft Paper to the valve of synthetic woven bags is not the correct and long term solution.

The Cement Industry is in a lucky position to have the availability of 4 kinds of bags for packing, i.e. (1) JUTE BAGS, (2) MULTI-WALLED KRAFT PAPER BAGS, (3) PLAIN HDPE/PP WOVEN BAGS IN NATURAL OR ANY OTHER COLOURS AND (4) KRAFT PAPER LAMINATED HDPE/PP WOVEN BAGS. As
such the Cement Industry can cater to requirement of all segments of society properly.

Thus synthetic Woven Bags, both natural white and coloured, are cheaper to use, give better look to the packed cement, save 28 loss of Cement due to seepage or burstage in handling and have a definite consumer appeal.

POLYPROPYLENE (P.P.)

Bags which are manufactured from PP can withstand higher temperature i.e. upto 100 °C. Proper quantity of additives has been mixed, so that PP Woven Fabric does not get deteriorated when exposed to sun light. PP is slightly rough in appearance and printing of PP is more resistant in comparison with printing on HDPE.
Evolution of systems for proper packaging and transportation of cement are based on certain specific considerations. Cement is a material, which is produced where raw materials eg limestone are available and not where it is to be used in constructions. As a result, the average distance of movement of cement in India is of the order of 750 km, entailing multiple handling at various stages. Secondly, in relation to its weight, cement is a cheap bulk powdery material, whose packaging and distribution costs are relatively higher, of the order of 40 per cent or more, in different countries. In India, these comprise nearly one-third of the net selling price. In addition, it must be borne in mind that transportation of cement and its subsequent use after storage at site exposes the hygroscopic material i.e. cement to possible deterioration in quality due to pro-hydration in contact with moisture and pre-carbonation in contact with atmospheric carbon-di-oxide, which have to be guarded against.
It is for these reasons that the systems of packaging, be it in bags or bulk, as well as for distribution of cement, based on the economical interaction of sea, rail and road transportation, require careful consideration. Robust and seepage-proof packaging, highly functional terminals and effective handling systems are parts of any optimised distribution system to ensure consumers the right quality of cement in right quantity and at the right time. Barring sporadic instances, the proportion of cement moved in bulk in India is very small. Nevertheless, in many appropriate situations bulk supply of cement may prove technically and economically attractive. With increase in the production of cement in the country, quality and efficient distribution will form the major planks of marketing strategy. Optimal packaging and distribution systems have, therefore, to be worked out and bulk supply of cement is expected to have a significant share in the near future.

At the instance of the Development commissioner for Cement Industry, NCB, in association with RITES, is presently engaged in a detailed techno-economic
feasibility study of bulk movement of cement by rail in a certain corridor, the results of which are expected to be available in a few month's time. Meanwhile, NCB has carried out detailed techno-economic viability studies of bulk movement of cement by road. This paper presents the salient findings of such studies.

ADVANTAGES OF BULK SUPPLY OF CEMENT:

There is a growing trend all over the world towards the use of bulk packaging for cement. In some developed countries, as much as 92 per cent of cement is being packed in bulk as can be seen from statement ahead. In the developing countries too, bulk packaging is gradually increasing its share. Bulk packaging has the following advantages:

a) The cement is obtained in proper quality and quantity in transit and handling is negligible.

b) Possibility of pilferage is minimised.
c) Effects saving in freight and packaging charges, compared to bag packing.

d) Enables exact scheduling of deliveries, thus eliminating the problems of uncertainties of availability of rail wagons and rail movements.

e) Direct dispensing of cement into silos saves time and money in rehandling.

f) Storage in silos/hoppers occupies less space and is safer.

g) Cement 'First-received first-consumed' is ensured unlike when stored in bags in sheds and godowns.

THE SYSTEM:

Bulk packaging of cement involves loading of cement directly into bulk containers at the cement plants and transporting by road, rail or waterways to the site of consumption which could be an industry, e.g., a readymix...
concrete plant, prefabrication unit, asbestos cement plant or large construction site like dams or bridges having central concrete batching and mixing plants and silos for storage. Cement in bulk can also be transported to an Intermediate Distribution Point (IDP) form where it is further redistributed to the consumers in suitable containers of smaller capacities.

The bulk movement of cement was adopted in the past at large construction sites like dams. For road movement the containers and trucks were mostly imported and their capacity was limited to around 6.5 tonnes. Whereas for rail movement, ordinary box type wagons were used. The distance of transportation was upto 150 km.

The system of bulk packaging mainly consists of (a) loading facilities at plant (b) transportation facility by road, rail or waterways and (c) unloading facility at the consuming site. Special attention need to be paid to system design taking into account the conditions prevailing in the country like plant layout (especially of old plants), long distance of transportation and small consumers. These will have bearing on the systems
of loading from the silos to the wagons as well as the infrastructure to cater for both bulk and bag supply simultaneously.

WAGONS

The practice so far for bulk movement of cement in India has been to load cement in loose condition in open trucks, open railway wagons, covered four-wheelers or eight-wheeler raily wagons with standard three flap doors on either side. Open trucks and open wagons are covered with tarpaulins on the top after loading, whereas in case of covered wagons, the flap doors are closed with water-proof linings at the joints. Thus filling and loading of bulk cement so far has been manual and rather crude.

Since these wagons are not made for this purpose, considerable operating problems are faced while filling and emptying these wagons. Moreover there is a possibility of deterioration in the quality of cement due to moisture ingression, seepage and pilferage. The development of special rail wagons for bulk cement has
not received favourable response so far since it involves certain economic parameters like ownership of wagons and empty returns which are yet to be solved.

NCB has developed two different types of containers, which are suitable for bulk movement both by rail or road.

(a) Vertically mounted multipurpose container which could be used for movement of material other than cement on its return journey or otherwise (for more details please refer to CRI Technology Digest on "Appropriate System for Bulk Packaging of Cement in India", June 1984.

(b) Portable containers of smaller capacities which could be filled in the cement plant or IPD and transported in open wagons or trucks. Such containers can also be used as silos at the consuming site when mounted on a suitably made platform, in case the construction site is not equipped with a concrete batching and mixing plant or a silo.
The use of portable containers does not need any special arrangement for transport and are equally suitable both for road and rail movement. Even open wagons could be used.

Till the problem of ownership of wagons is settled, the mounted containers can be put to use in road movement, along with the portable ones. It will not be difficult for an asbestos cement plant or a prefabrication unit to maintain a fleet of road container-carriers which will pay back in a very short period of time and in addition give advantages like flexible and pilfer-proof operation, exact scheduling of deliveries, guarantee of quality and quantity, and so on.

INTERMEDIATE DISTRIBUTION POINTS (IDP)

In case of bulk supply to different consumers, the Intermediate Distribution Points (IDP) located near large cement-consuming urban centres like Bombay, Delhi, Calcutta, Madras, Bangalore, Kanpur etc. , will be needed.
Cement stored at an IDP can be further redistributed packed in containers of suitable capacity, to meet the diverse requirements of consumers, big and small. One major element of cost is that of land, which has to be accessible by railways also.

INVESTMENTS AND COSTS:

For the reasons stated above, cement plants would have to maintain an appropriate mix of bulk and bag packing facilities. The capital investment for bulk packaging in the plant is expected to be of the order of 200 lakhs for a 3000 tpd plant and about 100 lakhs for a 1200 tpd plant. The investment cost of bulk loading installations above 900 tpd is lower than the corresponding cost of bag packing installations. The operating cost of bulk loading installation is lower than that of bag packing unit for various capacities. Investment cost of a 21 tonne multipurpose container-carrier assembly is estimated to be about 10 to 15 lakhs.
CONCLUSIONS:

i) In many situations, bulk supply of cement proves technically and economically attractive. It is logical to presume that a concerted beginning in this direction will be made during the current five-year plan.

ii) In view of the substantial quantity of cement moved by road, flexibilities rendered and lower investments, bulk supply of cement by road can be immediately resorted to. The system design and infrastructure are indigenously available.

iii) All large construction projects consuming substantial quantity of cement on sustained basis be encouraged to adopt bulk supply of cement. Road transportation would seem to be preferable in most situations.

iv) For metropolitan centres of consumption, bulk supply of cement and further distribution from IDPs to the consumers by rail and road is also economically viable.
v) By judicious planning and scheduling, empty return of rail or road tankers can be minimised, thereby improving the economics further.

**BULK PACKAGING OF CEMENT IN OTHER COUNTRIES**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Name of the Country</th>
<th>Cement Packed in Bulk (%)</th>
<th>Cement Packed in Bags (%)</th>
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<tr>
<td>1.</td>
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<td>Switzerland</td>
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<td>5.</td>
<td>Finland</td>
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<td>7.</td>
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<td>India</td>
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