How to produce quality crumb rubber

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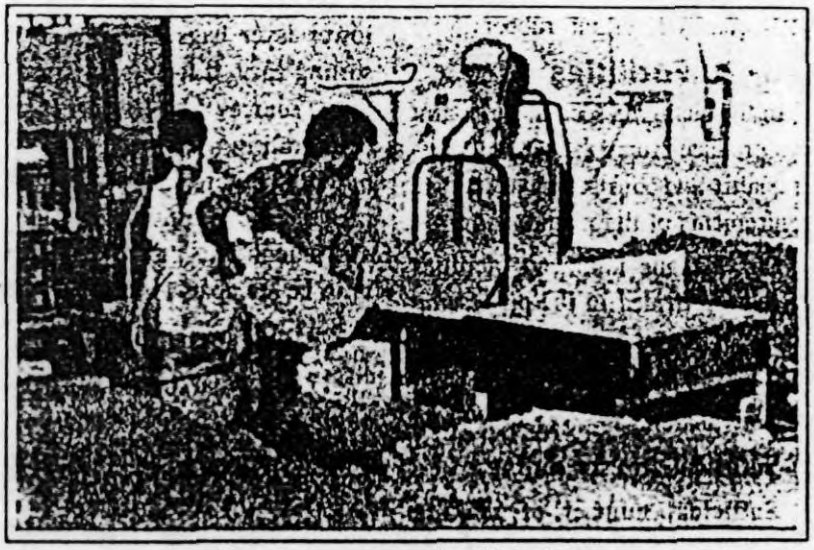
Rubber products must have quality and consistency in performance for facing global competition. To achieve this, the material should be of good quality and the processing method should be modern and scientific

How to produce crumb rubber with better quality and consistency to suit the requirements of the manufacturers? What are the facilities to be provided in the crumb rubber factory? What methods and process should be adopted in a factory to achieve quality and standard?

The liberalisation process has made much headway in recent months. Yet, even now, we have a closed market system in which most of the rubber and rubber goods produced in the country is completely consumed internally irrespective of its quality. But the situation is bound to change drastically in the coming months. According to the Government policy, there will be an open market system in the near future and hence there will be global competition for raw material as well as products. This means that only quality items will survive and this is true with regard to rubber and rubber products also.



Processing in a crumb rubber factory

For example, in tyre, the quality and consistency in performance are the important criteria for preference of a specific brand. This implies that all types should have good mileage, low failure rate, good retreadability etc. To achieve this, the prime requisite is the quality and consistency of raw materials. Since rubber is the main raw material for the manufacture of rubber products the level of quality and consistency is very important. If this can be achieved in technically specified rubber (TSR) particularly in ISNR - 20, major industries producing tyres, belting, hoses etc., will definitely show a preference to TSR and the market potential of crumb rubber can be improved.

Even though sheet rubber is the major raw rubber used by these industries for technological advantages, they are also facing serious processing problems such as high premastication time, high heat generation during compounding and high viscosity variation. With crumb rubber particularly ISNR - 20, these processing problems are comparatively less.

Yet, in practice, it is seen that the level of consistency is less between factories, between batches and even between bales. This is particularly true with ISNR 10, 20 and 50. It is

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because the system of processing practices adopted in many factories is not aimed at producing crumb rubber with better quality and consistency.

A close watch will reveal that the processing is done on the "first come first served" basis. Since scrap rubber being widely varying in quality, the system of processing is the main reason for not achieving consistency and better quality in crumb rubber.

Facilities

In the changing scenario, the aim is to produce crumb rubber with better quality and consistency to suit the requirements of the manufacturers.

For this, the following facilities are to be provided in the processing factory:

1. Sufficient area to store at least 15 days raw material.
2. Sufficient area for sorting.
3. Sufficient number of soaking tanks to give 24-28 hours soaking.
4. A pre - breaker to chop the scrap into pieces.
5. Large elliptical blending tank with endless movement of the chopped pieces of rubber with a trap to collect only a small quantity at a time for further processing. To ensure better homogeneity, the capacity should be at least one to two tonnes.
6. A pre - cleaning hammer mill.
7. A secondary blending tank elliptical in shape with endless flow arrangement with trap to collect crumbs for creping.
8. Sufficient number of crepers to give 10-12 passes for better shearing of the rubber.
9. Final size reduction hammer mill.
10. Small elliptical endless blending tank for collection of final crumbs.
11. Diesel or electric drier with capacity to produce the desired output.
12. Hydraulic press.
13. Large storage area for finished products to hold 15-30 days production.
14. Laboratory with all testing facilities. A typical layout of a 10 TPD (10 tonnes per day) crumb rubber factory is given in Fig. I.

Sufficient area is to be earmarked for storage of scrap rubber in gunny bags. Piling up should not be more than 5-6 bags to avoid compaction of lower layer bags in order to make sorting easy. If loose scrap from different sources is brought in, it should be spread in a mixed condition at a height not more than 60 cm. Sorting area shall be near the store area for easy handling. Atleast 30-50 m^2 area is to be set apart for sorting.

Wrong impression

The general impression is that sorting of scrap rubber is a wasteful exercise since it demands a lot of labour and hence increased cost. But this is a wrong impression. The labour cost involved in sorting will be more than compensated by way of improved quality, and low wear and tear of machinery, saving of water required for clearing etc. The scrap is carefully sorted to remove visible impurities such as bark particles, vulcanised rubber, jute and polypropylene fibre, stones, metal pieces, spouts, sand and dirt particles etc. It is very important to remove black shell from the scrap while sorting since the reason for low Po and PRI is mainly due to the presence of block shell.

The holding capacity of each soaking tank need not be more than half a day. The common practice of soaking is to charge the tank with a large quantity of scrap particularly in gunny bag shape and then filling water till the scrap floats as a huge mass totally preventing any sort of blending in the soaking tank. For better homogeneity and blending the following method may be adopted.

The tank is first filled to about one - third its level with water and then the sorted scrap in loose condition is charged into it. Since rubber is floating, a further blending is possible with the incoming scrap to a certain extent. The blending can further be improved with a paddle during the initial stage of soaking. Soaking of scrap in the loose state improves wetting of scrap there by loosening and settling of adhered dirt. Since rubber is always floating, spray arrangements may be given from horizontal pipes just above each soaking tank so that complete wetting of the surface layer of rubber is made possible. A soaking period of 24 - 48 hours is sufficient to loosen all dirt and soften the rubber. Longer soaking time is not desirable as it may lead to low Po and PRI.

Ideal machinery

Pre - breaker is an ideal machinery for initial size reduction of scrap and removal of dirt. Initial size reduction followed by blending in a large elliptical endless tank fitted with water jets for the continuous movement largely improves the blending of rubber. The minimum capacity of the tank is to hold around 1-2 T of rubber. The blending is further improved by intermittently removing small portions of the already blended rubber from the trap of the blending tank. The rubber so collected is further allowed to crumble into smaller pieces in a pre-cleaning hammer mill followed by blending in another similar blending tank. The second stage reduction in size in the pre-cleaning hammer mill further removes large amount of dirt. From the trap of the second blending tank also small quantity of rubber is taken at a time intermittently for creping operation. The water in both the blending tanks is to be changed in every shift.

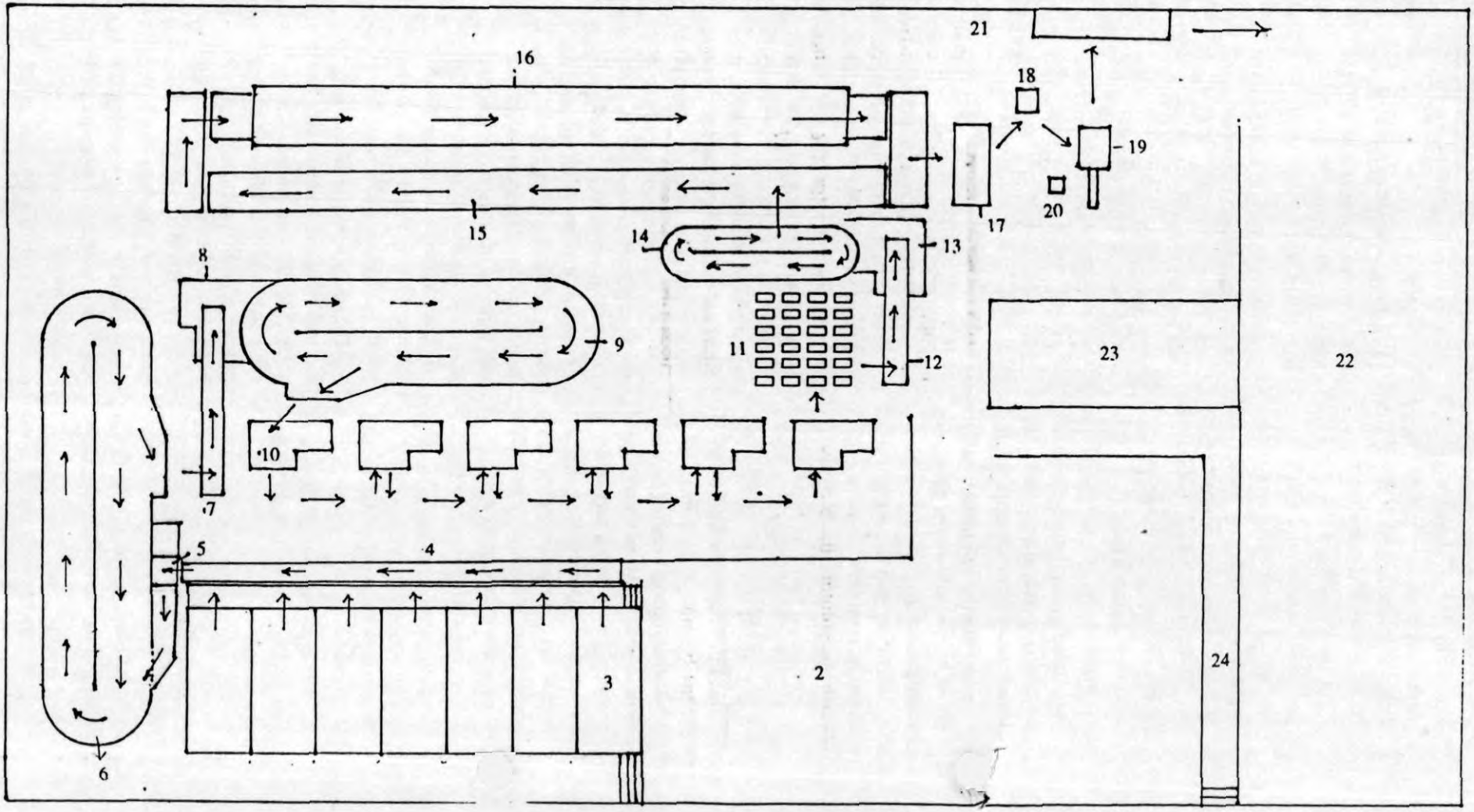
The crepers are to be arranged side by side each at a spacing of at least of one metre between the sets. A

Typical Layout of a 10 TPD Crumb Rubber factory

1.	Raw material store	9.	Secondary blending tank	17.	Table
2.	Sorting area	10.	Creper	18.	Weighing scale
3.	Soaking tank	11.	Folded creper	19.	Hydraulic scale
4.	Belt conveyor	12.	Belt conveyor	20.	Control panel
5.	Pre breaker	13.	Final Hammer Mill	21.	Packing table
6.	Primary blending tank	14.	Crumb collection Tank	22.	Product store
7.	Belt conveyor	15.	Return track	23.	Tool room
8.	Pre Cleaning Hammer mill	16.	Drier	24.	Entrance

Fig - I

Scale: 1:200



sloppy work area having at least 2-3m width is allowed for easy wash out of dirt and free stacking of crepes. Creping is an important operation which decides the nature of drying of the crumbs. In general if lumpy materials are more, the chances of white spots in the dried crumbs are also more. To avoid this, while sorting, lumps are to be segregated, crepe them separately and then blended with the main crepe in small proportions. At least 10-11 passes are required for smooth creping.

After each pass in a creper, the crepe is folded lenghtwise and a second pass is given. This operation improves the sharing and blending of rubber. Large working area allows stacking of crepes by the side of each creper so that creping in a random manner in the next creper is possible. This also will improve the blending of rubber. Good spray of water is allowed in each creper for better washing and removal of dirt from the crepe. The thickness of the final crepe should not be more than 4 mm for better size reduction in the final hammer mill. The final crepes may be folded and systematically arranged in front of the final hammer mill or the conveyer leading to the hammer mill.

Uniform drying

The crepes are taken randomly from the stack and then fed to the final hammer mill through a belt conveyer. A small amount of castor oil (0.1% on the rubber i.e., 1 kg oil/ T. of rubber) is also applied on the crepe while feeding into the hammer mill. Application of castor oil facilitates fine crumbling of the crepe and induce uniform drying in the dryer. The crumb collection tank should also be an elliptical endless one with water jets to induce flow and better blending of the crumbs. The tank should be lined with white glazed tiles to check the clarity of water in the tank. The water in the tank has to be changed after filling every 3-4 boxes with crumbs.

Six compartments

The boxes are made of either aluminium or stainless steel with six compartments in two layers normally. Each layer is having a bottom perforated support. While filling the bottom layer, care should be taken not to fill it to its capacity. Only 70-80 per cent of its capacity is filled with crumbs to allow free air gap and the upper layer to its full capacity. This ensures better drying of both the layers. Further while loading, each tray of crumb collected from the crumb collection tank (CCT) is to be fed in each compartment of the box and thus gradually filled to the desired level. This will further enhance the blending and improve consistency. If further improvement in Po and PRI is required, the crumbs in the box may be sprayed with a solution containing 0.5 per cent of phosphoric acid and 0.25 per cent tetraethylene pentamine for about 10 minutes. The crumb may be allowed to drip for atleast one hour before feeding to the drier to minimise entry of moisture in the drier. The dripping can be further enhanced by diverting the hot air from the inlet of the drier to a filled box just outside on the return track. The inlet and outlet temperature can be maintained at 100°- 105°C and 85-90°C respectively. The temperature of the other zones may be kept in between. The usual drying time is around 4-4 hours. There should be a cooling area to bring down the temperature of the exit box below 60°C.

If proper sorting of scrap is done and systematic blending facilities are provided in the factory the quality and consistency of crumb rubber can be improved to a large extent

Pressing and packing

The dried crumb biscuit from each compartment of the box is to be placed on a fairly large table covered with aluminuim sheet to avoid any contamination and randomly broken to see the degree of dryness. A time lag of 10-15 minutes is to be allowed between pressing and packing to prevent sweating inside the polythene wrap. The polythene cover should contain necessary identification marks such as block number, batch number, grade, date of processing, name of company etc. Samples are taken from 10 per cent of the blocks. Each sample consists of two pieces taken vertically down from diagonally opposite corners of the selected block. Two tonnes of crumb i.e., 80 blocks may be considered as one batch. Eight samples from 5, 15, 25, 35, 45, 55 65 and 75 blocks may be taken. The samples are then tested for Po, PRI and dirt and statistically analysed using mean + 3 SD formula. The composite of all the eight samples may be tested for ash, volatile matter and nitrogen and based on the results grading is done. If the results fail to sastisfy a particular grade, then the whole batch is down graded.

Stacking

The block will lose its shape if more weight is applied on it. Hence stacking should not be more than 5 layers high to minimise cold flow. Wooden platform may be arranged on the floor for stacking the crumb and to avoid wetting by contact with floor.

If proper sorting of scrap is done and systematic blending facilities are provided in the factory, the overall quality and consistency of crumb rubber can be improved to a large extent. □