

Equipment for Removal of Sand from Beach-dried Spratts

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Sand adhering to spratts (a major item of dry fish exports from India) dried by the conventional sun-drying technique, affects adversely the export quality of the fish. A simple equipment designed and fabricated for the removal of sand from the fish is described. The equipment consists of a wire mesh drum provided with three horizontal coir brushes supported on a central shaft. The drum and the brushes rotate in opposite directions, providing the desired abrasive action for cleaning the fish. The operational conditions for attaining maximum cleaning efficiency (removal of 70-80% of the sand originally present) have been worked out.

SPRATTS (*Anchoviella* sp.) form a major item of dry fish exports from India to Ceylon. On an average about 5000 tons of Spratts valued at about Rs 80 lakhs were exported to Ceylon during the period 1959-1966. Larger quantities of this fish are landed in and around Cape Comorin starting from Pondicherry in the east coast up to Cochin in the west coast, the maximum landing being from Tuticorin to Quilon. They appear in larger shoals near the shore and are available only from January to September. Of the various species, white and black varieties are the most predominant ones.

Since Spratts are generally caught in large quantities at a time, their handling and preservation become difficult. Because of the non-availability of an economical artificial dryer to handle such huge quantities of fish, sun-drying on sandy beach has been found to be the only economic means of preservation. However, with this mode of drying, considerable quantities of sand and dirt (7-21.4%) get admixed with the fish. According to the relevant Indian Standards Specification (IS: 2883-1964), the amount of acid insoluble ash (i.e. sand) in this material should not exceed 7%. The need for a mechanical device which

can reduce the sand content to a level below the specified limit at a nominal extra cost has been keenly felt. A cleaner designed and fabricated at this Institute using indigenously available materials is described in this communication.

Description of the cleaner

The cleaner (Fig. 1) consists of a wire mesh conical drum supported on a hollow shaft. Three coir brushes are placed inside the drum and are supported on a central shaft which passes through the hollow shaft. Both the drum and the brush shafts are rotated in opposite directions by a suitable drive mechanism. Material fed at the smaller diameter end of the drum through a conical charging door travels towards the discharge end due to its slope. By the time the material reaches the discharge end, it gets cleaned and can be removed through a lever operated discharge door. The sand removed from the material by the rotating brushes is let out automatically through the wire mesh drum which acts as a sieve.

The dimensions of the various components of the cleaner are as follows: Charge end diam., 615 mm; discharging end diam.,

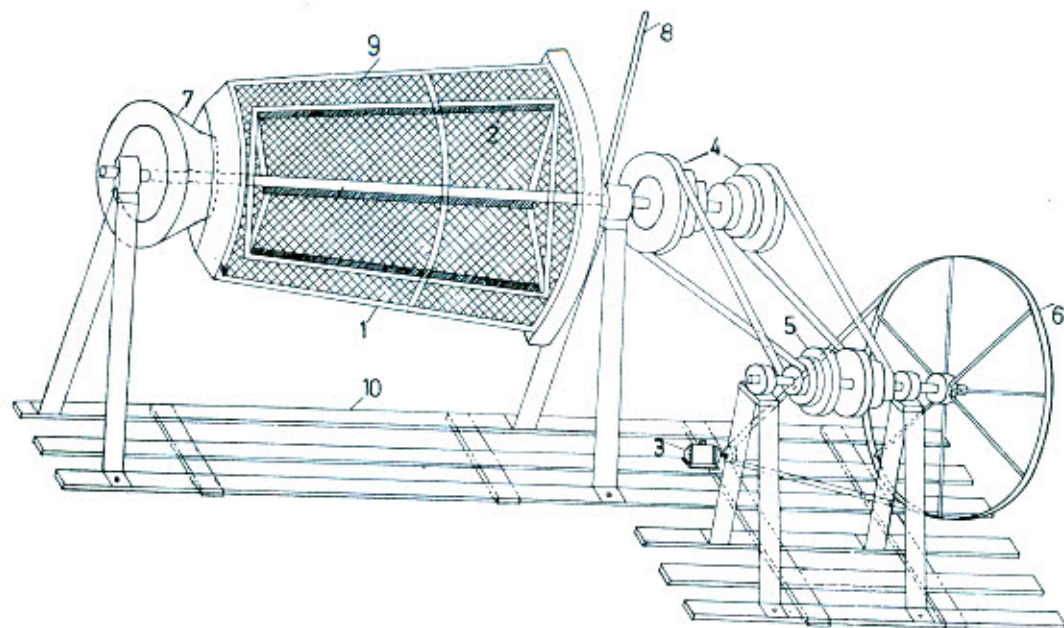


Fig. 1—Mechanical fish cleaner [(1) Wire mesh drum (charging end diam. 615 mm, discharge end diam. 690 mm); (2) coir brushes (3 Nos) (900 × 50 × 50 mm); (3) electric motor (1 hp); (4), (5), (6), step pulley, variable speed and direction drive system; (7) conical charging door; (8) lever operated discharging door; (9) G.I. wire mesh (3 mm sq); (10) wooden base. Capacity of the cleaner, 40-50 kg/hr]

690 mm; length of the drum, 920 mm; size of the coir brushes (3 Nos) 900 × 50 × 50 mm; clearance between the brush and the drum, 10-13 mm; and capacity of cleaner, 40-50 kg/hr.

Cleaning trials

Experiments were performed using 500 g lots of the material to study the effect of various factors like moisture content, number of passes, speed of rotation, condition of the feed material, etc. on the cleaning efficiency of the cleaner and the breakage suffered by the material during cleaning.

The material used was collected from dry fish exporters in Pondicherry, Tuticorin, Mayavaram, Colachel, Cape Comorin, Varakala, Quilon and Cochin area. For comparative studies, fresh raw fish dried in a laboratory dryer was used.

Effect of moisture on cleaning efficiency—The various operational conditions for these

experiments were: Initial sand content of the material, 7-10%, initial breakage (head detached from the main body), 1-5%; and speed of rotation of the brush and the drum, 50 rpm. Under these conditions, samples with moisture content in the range 12-16% suffered a breakage of 15-17% and had a final sand content of 2-3%. For material outside this moisture range, the breakage and final sand content were both high—40% and 3% respectively.

Effect of quality of feed material on cleaning efficiency—From a lot of dry fish, the spoiled and the unspoiled fish were separated out by hand picking. Only such fish were taken as had not suffered initial breakage. The initial moisture content of the material was 15-16%. On passing the two lots separately through the cleaner under similar operational conditions as in the above experiments, the spoiled material (TVN value >120 mg/100 g) suffered a breakage of 28-32%, while the breakage in the case of unspoiled material was very

low (5-6%). The sand content and the loss in cleaning were 2.25 and 4.7% respectively in the case of the unspoiled material. The corresponding figures for the spoiled material were 5.6 and 11.12% respectively.

Effect of number of passes and speed of rotation on cleaning efficiency—With 3 successive passages of the same material through the cleaner under the same operational conditions as in the above experiments, the extent of breakage increased from 3.4 to 7.2% and the final sand content fell from 1.1 to 0.08%. With speed of rotation of the drum and the brush around 50 rpm, the extent of breakage and the final sand content were 15.16 and 3% respectively. There was no improvement in respect of either breakage or the final sand content on varying the speed of rotation.

Variation of cleaning efficiency with the initial sand content—Keeping the speed of rotation of the drum and the brush constant at 50 rpm, different lots of the material with varying initial sand and moisture contents were passed through the cleaner. The data presented in Table 1 show that the cleaning efficiency increases with increase in the initial sand content in the material. However, the sand content in the cleaned material is higher, the higher the initial sand content. On the whole the machine removes 70-80% of the sand initially present in the feed material.

Effect of varying wire mesh size on cleaning efficiency—For these experiments, wire

gauge of different mesh sizes was used in forming the drum. The optimum mesh size was found to be 3 mm sq. Use of gauge of mesh size higher than this led to increased breakage, while wire gauge of mesh size less than 3 mm sq had a detrimental effect on the sieving action and consequently the cleaning efficiency of the cleaner.

Discussion

The cleaning done by the cleaner is due to the abrasive action of the brush and the wire mesh drum. Sand adheres to the fish in three different ways, viz. loose sand, sticky sand and embedded sand. The loose sand, often found on beach dried White Bait, is very easily removed. Sand sticking to the surface and that embedded below the slime surface is, however, very difficult to remove. The former could be almost completely removed with the cleaner. The brush and the wire mesh perform several functions simultaneously, viz. (1) brushing action on both sides of the fish; (2) agitation of the material, thereby exposing fresh uncleaned surfaces; (3) sieving of the material; and (4) movement of the material towards the discharge end.

The cleaner brings down the sand content of fish to a level (3-5%) well below that specified in the Indian Standards Specification. The final quality of the product in respect of sand content and breakage depends upon several factors, viz. sand and moisture content of the material, its degree of freshness, speed of rotation, wire mesh size, etc.

The optimum moisture content of the material for reducing breakage to the minimum and obtaining a product with minimum final sand content was found to be 12-16%. The condition of the cleaned material also depends considerably on the quality of the original material. The high incidence of breakage in spoiled fish is due to the fact that the fish is devoid of the belly portion and the head is connected to the body by a slender backbone, the junction of which is the weakest point and breaks easily due to the abrasive action.

Table 1—Extent of sand removal from feed materials with different sand and moisture contents

Initial sand content %	Initial moisture content %	Sand content in cleaned material %	Breakage %	Loss on cleaning % (by wt)	Cleaning efficiency %
7.3	17.00	2.86	17.00	13.00	70.3
10.0	15.22	3.76	19.53	14.94	71.5
21.4	16.09	5.76	17.83	14.66	79.80

As the soft belly is exposed to the brushing action, fish muscle loss with sand is more in spoiled fish.

The sand content of the cleaned material is higher for lots with higher initial sand content. This is probably due to the fact that with higher initial sand content, the percentage of embedded sand, which is difficult to remove, is also higher. It is seen from Table 1 that the cleaning efficiency of the cleaner increases with increase in sand content in the feed material, but the overall efficiency lies in the range 70-80%.

A typical sample of sand removed from the fish when analysed was found to contain 80% acid insolubles, the rest 20% being calcium, moisture and organic matter.

Conclusion

(1) With the equipment developed, the sand content of Spratts can be reduced from 7.21-4% to 3.5%.

(2) During the cleaning process, there is a weight loss to the extent of 12-14%, which is mainly due to the loss of sand.

(3) Breakage occurs to the extent of 15-16%, which is reduced to a minimum, when the moisture content of the product is 12-16%, the optimum moisture range.

(4) The speed of rotation does not have a marked influence on breakage or on the

sand content of the product (i.e. the cleaning efficiency), but rotation in opposite direction is essential for cleaning.

(5) Breakage is directly influenced by the size of the wire mesh. Mesh size greater than the optimum size (3 mm sq) increases breakage, while smaller mesh size destroys the sieving action and lowers the cleaning efficiency.

(6) The cleaning efficiency of the equipment increases with increase in the sand content of the feed, but the final sand content of the product also increases. The equipment enables the removal of 70-80% of the sand present initially.

(7) The equipment is effective only if the material used for cleaning is prepared from fresh raw material. If the raw material is spoiled, breakage and loss are appreciable enough to offset its advantages.

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