Design and Fabrication of a Tilting Kettle for Fish Processing Industry

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An electrically heated stainless steel jacketed kettle of 80 litre capacity working at a steam pressure of 1.06 kg f cm^{-2} has been designed and fabricated for cooking fish and prawn in the fish processing industry. The equipment which is provided with tilting arrangement and operational controls allows cooking at a constant temperature under hygienic conditions. The details of the design, construction and operation are described. The cost of the equipment is about Rs. 8,000/–. The economics of operation are also presented.

Cooking vessel is one of the most important equipment of any canning factory. Mostly, steam jacketed vessels are used for this purpose. Several types of designs have been reported in the literature (Carmichael, 1960; Heldman, 1975; Perry & Chilton, 1974). Both fixed and tilting types of vessels heated by direct fire or by steam are in use in canning factories. Steam operated vessels (jacketed type or immersion coil type) are preferred to non-jacketed direct fired type for canning of food, but direct fired type vessels are useful to small canning units where steam boiler is not available. They are cheaper and simpler in design. From technical point of view, jacketed type (indirect heating) are preferable to directly heated type vessels.

Considering the need of small scale canning industries, an electrical cooking kettle has been designed and fabricated as described in this communication.

Materials and Methods

Electrically heated stainless steel jacketed kettle consists of a conical stainless steel bowl, the shell of which has a lip for pouring the contents as shown in Fig. 1. The vessel can hold about 80 l of water and about 40 kg of prawn can be cooked at a time.

The stainless steel bowl is having an outer mild steel jacket welded at the periphery. The jacket can withstand a maximum steam pressure of 1.06 kg cm^{-2}. In the outer jacket two industrial type immersion heaters each having a capacity of 5 kw are fitted for the generation of steam. The vessel is supported on mild steel shafts welded on both sides of the jacket. The shafts are supported on a mild steel tubular structure with the help of bush bearings. The shaft is fixed with worm gear arrangement so that the vessel can be tilted easily using the hand wheel for unloading the cooked material. The worm gear and heater terminals are enclosed in metallic box coverings so that water will not fall inside. The jacket of the vessel is provided with safety valve, pressure gauge, water inlet pipe, drain pipe, steam cock etc.

Since the vessel is to be used for cooking fish, all contact parts such as bowl and lid of the vessel are made of stainless steel. The outer mild steel jacket is coated with heat resistant paint. The vessel can be worked

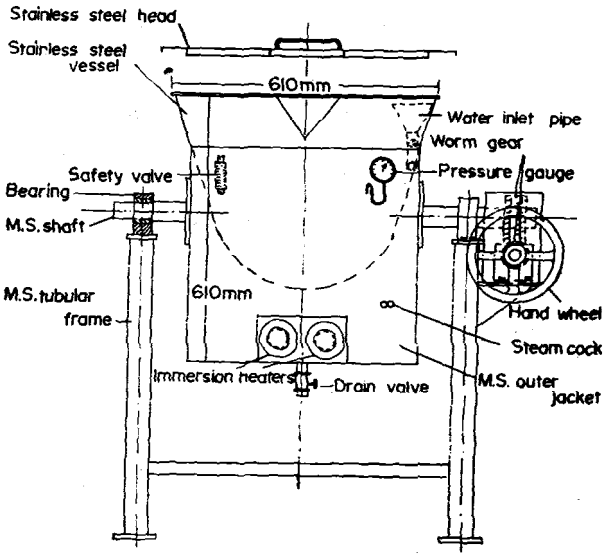

Fig. 1. Electrically heated stainless steel tilting kettle

on 230 volts, single phase mains. The temperature inside the jacketed kettle can be controlled by using control switches with indicator lamp provided with each heater, either manually or thermostatically.

Operational details

First of all the vessel is held in the vertical position and water is filled inside the jacket through the water inlet pipe after opening inlet valve up to the required level so as to immerse the heaters in water. The water level can be known by opening the steam cock fitted by the side of the mild steel outer jacket. Water has to be filled inside till it starts escaping through the cock. Now the vessel is ready for operation.

The materials to be cooked are fed into the vessel, required quantity of water is added and covered with the lid. The heaters are then switched on. Steam developed inside the jacket is allowed to escape through the valve. By this way air entrapped inside the jacket is removed and then all the valves are closed. The steam pressure starts developing inside the jacket and when it reaches the required pressure as noted in the pressure gauge, either of the heaters can be switched off so as to maintain a constant pressure of steam in the jacket. If the pressure exceeds the desired limit it can be vented off by a steam cock and in the event of high pressure, excess steam will escape through safety valve which is kept adjusted to the required pressure limit.

Materials can be cooked at any desired temperature and correspondingly steam pressure in the jacket is adjusted. After cooking, the heaters are switched off, the cooked material is taken out completely by tilting the vessel with the help of handwheel. The kettle is washed well using water after each operation.

Results and Discusssion

Experiments were conducted to study the efficiency and economics of operations of a conventional steam jacketed kettle and electrically heated steam jacketed kettle. For this purpose an identical stainless steel steam jacketed kettle was taken. Both the vessels were filled up with equal quantities of water and water was allowed to evaporate for a certain length of time. Quantity of water evaporated in the steam kettle and corresponding steam consumption (obtained by collection condensate) are given in Table 1. Similarly, quality of water evaporated and corresponding electrical power consumed by electrical kettle are also noted. From these data, economics of operation of the two vessels and their efficiencies are compared.

Table 1. *Details of steam and electrical kettle*

Description	Steam kettle	Electric kettle
Come up time, h	0	0.5
Initial volume of water, *l*	40	40
Final volume of water, *l*	10	10
Water evaporated, *l*	30	30
Evaporation time, h	2.5	4
Efficiency of evaporation. l h^{-1}	12	7.5
Steam consumed, kg	45	—
Electricity consumed, kwh	—	40
Total cost of operation		
a) Steam @ 0.50 Re. kg^{-1}	Rs. 22.50	—
b) Electricity 0.30 Re. kg^{-1}		12.00
Cost of evaporation Re./l	0.75	0.40
Cost of kettle, Rs.	7,000	8,000

Though the initial come up time of the electrial kettle is more than the steam heated kettle, the cost of evaporation of one litre of water in steam kettle is Re. 0.75 whereas it is only Re. 0.40 in the electric kettle. With respect to equipment cost, electrical kettle is costly. Cost of this electrical kettle is estimated as Rs. 8,000/- whereas similar steam jacketed kettle the cost is Rs. 7,000/- but electrical kettle does not require a steam source such as boiler, the cost of which is normally beyond the capcity of a small scale entrepreneur. This is easily handled and no specially skilled labour is required for its operation. Moreover the operating cost is also very low. Considering the overall economics this elctrically operated kettle is highly useful for small scale unit.

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