## Vibrational Self-Cleaning Filter for Cleaning of Inedible Fat

E.D.ZAITSEV

Semipalatinsk Technological Institute of Meat and Milk Industry, 490011 Semipalatinsk, Glinka Street, 49, USSR

SUMMARY: A new design of self-cleaning vibrational filter-pump is offered. Experiments at the model unit for filtration of technical fat have shown that the content of particles insoluble in ether decreases from 0.5-0.6 to 0.2-0.3 %.

Method of physical modelling has determined optimum frequency and amplitude of vibrations, live section area, cells dimensions of filter-partition, coneness angle of a nozzle, etc. Experiments carried out have made it possible to develop self-cleaning vibrational filter with the capacity of cleaning 0.5 $m^3$/h of technical fat from mechanical particles whose dimensions are over 20 mcm.

INTRODUCTION: At present cleaning of technical fat and broths from suspended dispersion particles is not mechanized and demands large labour and time costs. Attempts of utilizing trapped by floatation fat from sewage by means of heating it to liquid-fluid state and subsequent centrifuging haven't been successful because of its high dirt capacity resulting in quick choking up the centrifuge with dirt. That is why cleaning of technical fat, broths, sewage etc. containing a large amount of suspended dispersion particles is an urgent problem.

MATERIALS and METHODS: To solve the above mentioned task we offer self-cleaning vibrational filter (Zaitsev et al., 1989). The filter (Fig.1) consists of a body 1 with inlet

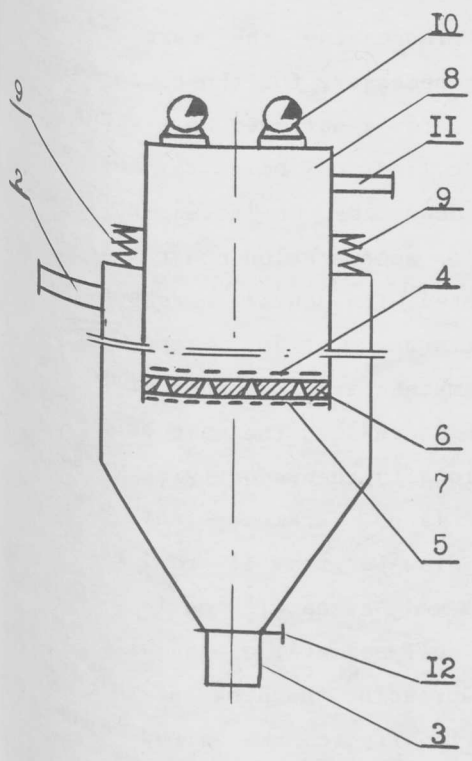


Fig.1. The Scheme of Vibrofilter.

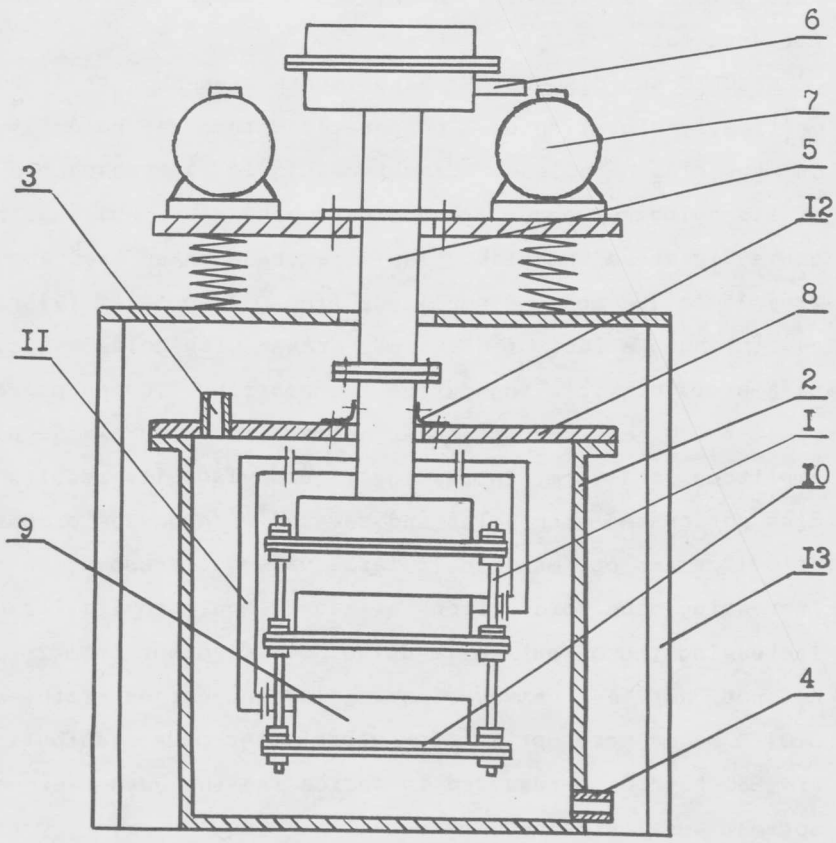


Fig.2. The Scheme of Vibrofilter.

and outlet pipes 3 for suspension and precipitate, filter-partition having inner bed 4 made of elastic filter material, e.g. cloth, porous rubber etc. and outer bed 5. Between filter beds 4 and 5 there is a device for cleaning filter-partition made in the form of a sieve 6 with cone-type holes 7. Filter-partition is mounted on the open end of the cylinder 8 resting on springs 9 and connected with vibrodrive 10. An outlet pipe 11 for filtrate is mounted on the cylinder. A pipe 3 has a valve 12 for periodical discharge of precipitate from the body. The filter works in the following way. Suspension is poured into the body 1 through the pipe 2 to the level exceeding the level of the arrangement of filter-partition beds 4 and 5. Then vibrodrive 10 is switched on. Vibration of filter-partition beds 4 and 5 and set between them sieve 6 produces pressure pulse and static pressure guiding suspension through filter-partition.Pressure pulsing produces direct and back flows, the back flow being weaker since consumption through confusor is more than that through diffusor and holes 7 of the sieve 6 are overlapped by filter-partition elastic bed acting as a valve. The back flow together with inertial forces cleans filter-partition from solid particles during every period. Filtrate is discharged through the pipe 11 from the filter. Solid particles are accumulated at the bottom of the body 1 at the pipe 3 and are discharged from the filter in the time of opening the valve 12. The latter can be opened either according to the set programme or on achieving the definite weight of solid particles. Evaluation of pump effect and the filtration quality was done by laboratory devices (Zaitsev et al., 1986, 1989) mounted on a vibrational electrodynamical stand VADS-200A and by a model unit the scheme of which is presented on Fig.1.

Investigation of vibrational self-cleaning filter's output during filtering technical fat was carried out by volumetrical method (with less than 5 % of errors) and the quality of its filtration was determined by the number of ether-insoluble particles in the initial and filtered fat.

RESULTS and DISCUSSION: Experiments have shown that for increasing the pump effect of vertically vibrating disk perforated with conic holes it is necessary for the gauze to be set on the side of a lesser diameter. Liquid is transported towards a narrowed hole irrespective of its being set above or underneath the disk. While using cylindrical holes, if the elastic gauze is above the disk, liquid is transported from above downwards. On increasing frequency from 15 to 100 cps and amplitude from 0.1 to 10 mm (vibration acceleration doesn't exceed 20 g) the pump effect of disks perforated with holes and covered with gauzes increases. Optimum parameters of vibration during transporting liquid up are frequency of 20-30 cps, amplitude of 3-6 mm and during transporting liquid downwards parameters are frequency of 50 cps and amplitude of 2-3 mm. Increasing liquid viscosity results in decreasing the pump effect of the disk perforated with holes and covered with gauzes proportionally to viscosity. Live sections of 3-12 % are optimum, their large values corresponding to large parameters of vibration. Increasing the proportion of canal length to its lesser diameter from 1.7 to 4 resulted in increasing the output while using hole diameter from 2 to 5 mm. Gauzes with cells of 0.25 mm do not act as valves. Canvas, lavsan, cotton cloths as well as metal gauzes with cells of 0.04-0.05 mm were optimum for vibrofilter-pump's output. Increasing the disk (sieve) diameter from 50 to 200 mm resulted in increasing the output proportionally to the sieve area, its optimum section being 10%.

Laboratory research of pump effect and quality of technical fat filtration made it

possible to design a model sample of vibrational self-cleaning filter-pump with the capacity of 60kg/h. The diameter of cylinder 8 and sieve of the model (Fig.1) was 100 mm. Inertial vibrodrive produced frequency of 25.5 cps and amplitude of 5 mm. Live section of the sieve was 6-10 %. During experiments cloths and brass gauzes with cells dimensions of 0.01 and 0.05 and nickel gauzes with cells of 0.02 mm were used as an elastic filter-partition. Experiments on technical fat filtration at the model installation have shown that it's best of all to use tar cloths and nickel gauzes. When they were used filter's capacity was rated being about 60 kg/h, substantial decrease of the capacity during 2 hours of work didn't take place. The number of ether unsolved particles reduced from 0.5-0.6% to 0.2-0.3%.

Experiments carried out have made it possible to develop self-cleaning vibrational filter with the capacity of 0.5 $m^3$/h for cleaning technical fat from mechanical particles whose dimensions are over 20 mcm and the scheme of which is presented on Fig.2 and 3.

Vibrofilter (Fig.2) consists of a body 1 with a removable cover 2, a pipe 3 for feeding suspension, a pipe 4 for precipitate discharge. A tube 5 with a pipe 6 for filtrate discharge is mounted inside the body and led out through the cover 2. The tube 5 is connected with vibrodrive 7. By means of rods 8 plates 9 are rigidly connected with each other forming a pack, one of the plates being directly connected with one end of the tube. There are filtering elements 10 mounted in plates 9. By means of pipes 11 inner cavities of plates are connected with the tube 5. Packers 12 are used for leading out the tube 5. Vibrofilter is mounted on the frame 13. Flexible, membrane or common electrical heaters are used for heating vibrofilter. It is also possible to use steam for body 1 heating. Vibrofilter (Fig.3) has a tube 5 led out through the bottom of the body 1 and a pipe 6 is connected with flexible hose

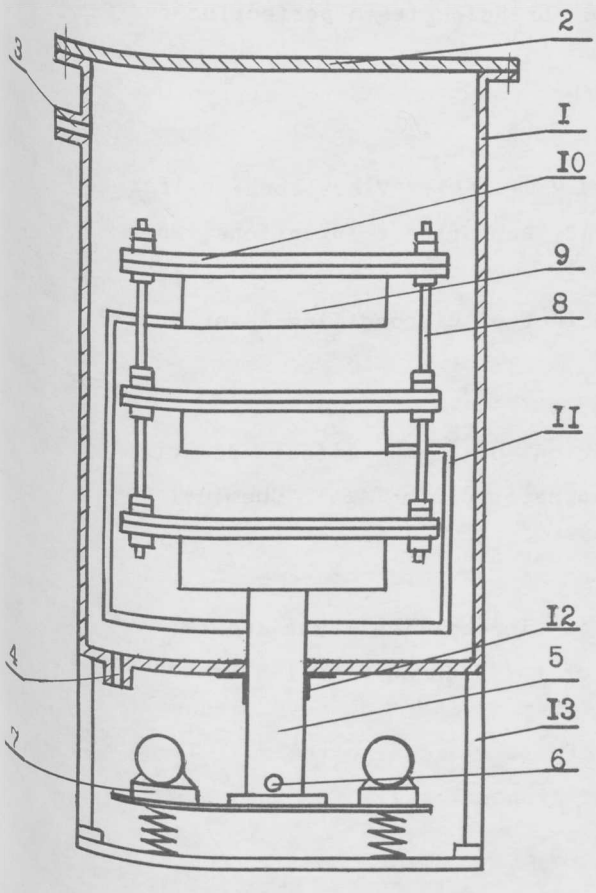


Fig.3. The Scheme of Vibrofilter.

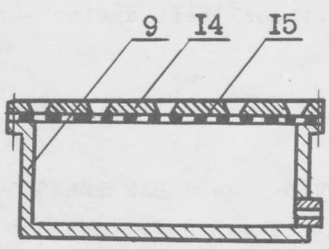


Fig.4. Plate.

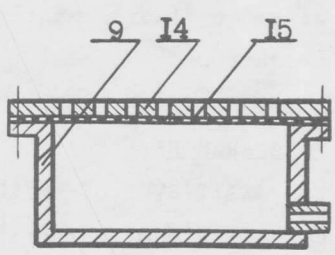


Fig.5. Plate.

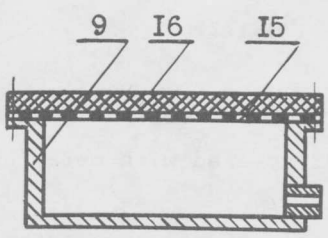


Fig.6. Plate.

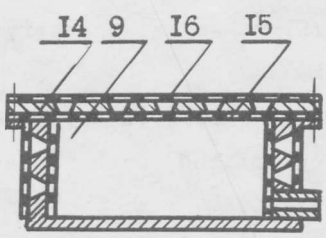


Fig.7. Plate.

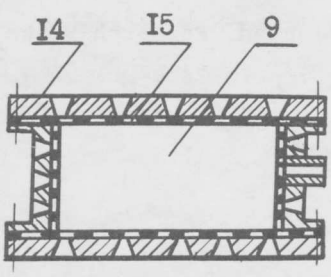


Fig.8. Plate.

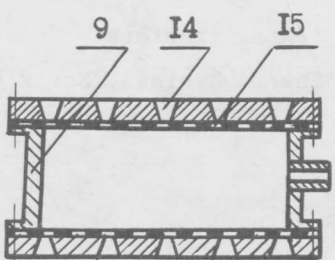


Fig.9. Plate.

or the system of pipes with fittings (not shown on the scheme). The flexible hose or the system of pipes with fittings are necessary for filling the tube 5 and plates 9 with filtrate in the tube and plates in the process of vibrofilter's operation. Fig 4-6 show plates one end surface of which serves as filtering element.

Fig.7-8 show end and side surfaces serving as filtering elements, Fig.9 - both end surfaces serving as filtering elements. At the same time Fig.4 shows the plate having the sieve 14 with conic holes and one elastic filter-partition 15 and on the Fig.5 the plate has the sieve with cylindrical holes. The version of making a plate shown on the Fig.6 which has a plate made of porous material, e.g. ceramics instead of a sieve with holes is also possible. Plates shown on Fig.7-9 have sieves with conic holes though vibrofilter design makes it possible to use the same plates having sieves with cylindrical holes. The choice of a plate design version depends on the required capacity of vibrofilter, composition of suspension subjected to filtration, the cost of manufacturing filtering element.

Vibrofilter pictured on Fig.2 works in the following way: vibrofilter is heated to the temperature of 80 - 100 $^{o}$C before operation. Then technical fat having the temperature of 70 - 90 $^{o}$C is fed to the body 2. Vibrodrive 7 is switched on. Due to the pump effects produced by the sieve 14 with elastic partition 15 fat passes through filtering elements 10 into the plate cavity 9 and further into the tube 5 wherefrom it is fed through the pipe 6 into a container for filtrate. Solid particles are periodically discharged through the pipe 4. Vibrofilter shown on Fig.3 works in the similar way.

CONCLUSIONS: A new self-cleaning vibrational filter for filtration of technical fat and other viscose liquids is offered. The author will gratefully receive suggestions of joint work at improvement of vibrofilter design and bringing it to perfection for commercial production.

REFERENCES:

ZAITSEV,E.D., MIKHAILOV,N.V. and BAZALBEKOV,YU.M. (1989): "Vibrational Filter". The USSR Certificate of Authorship No 1456187, ICL.VO1d.27/12, Bulletin of Inventions, No 5.

ZAITSEV,E.D., MIKHAILOV,N.V. (1986): Pump effect of vibroboiling layer in fluid media. In: "Chemical Industry". 3: 170-172.

ZAITSEV,E.D., BAZALBEKOV,YU.M. (1989): Evaluation of pump effect of vibrating disk perforated with holes and covered with metal gauzes or cloths. In: "Chemical Industry". 7: 522-526.

ZAITSEV,E.D. (1989): "The use of pump effect of vibroboiling layer and perforated disks in bioreactors. In: "Collected Research Works of the USSR AS Siberian Branch Institute of Thermophysics", Novosibirsk, pp.70-74..