

FRUIT JUICE FILTRATION TECHNIQUE IN CLEAR FRUIT JUICE AND LIQUOR PROCESSING

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Summary

Vietnam is a tropical agriculture country where can grow many kind of nice fruits for export by fresh or juice (clear or thick type), puree, liquor, wine ...

In clear fruit juice and puree process, it is imperative to use filter to separate clear juice and flesh of fruit.

In order to filter the juice, can use the followings:

- The continued filter with high investment at beginning as:

- Decanter from Alfa Laval
- Contipress from NETZSCH
- Centrifugal separator from GEA
- Belt filter

...

- The discontinued filter with the reasonable investment will be suitable for Vietnamese factories 's capacity, as:

- Manual plate and frame filter press (1st generation)
- Chamber filter press (fully automatic and semi automatic type) (2nd generation)
- Membrane filter press (fully automatic and semi automatic type) (3rd generation)

In the scope of this report, only mention some technical specification of two types of NETZSCH Filter Press: Chamber filter press and Membrane filter press what can be used not only for clear fruit juices but cooking oil and other industrial products also.

1. The principles of press filtration:

Filtration is a process of separating undissolved solid content out of liquid by filter cloths and filtration pressure (picture 1)

The finer filter cloths is, the more undissolved solid is kept on them at one site. And the filtration effect will be stricter.

The higher pressure of filtration, the more volume of filtrate and the filter cake was pressed hard on the filter cloths and filtrate will be clearer (picture 2)

Picture 3:

Introduce of main composition of filter press, consist of:

- *Feeding pump*: can use NEMO progressive cavity pump, centrifugal pump, piston diaphragm pump

or air diaphragm pump. Single infeed and double infeed.

- *Filter press*:

- Filtrate collection: open type and close type
- Cake discharge: fully automatic type or manual type

Picture 4:

Introduce one industrial filtration system for lime milk with membrane filter press (3rd generation) working continuously and automatically.

Lime milk at storage tank (4) be mixed with the additives in tank (2) and pumped to reaction tank (1) by the pumps (3) and (5). From this tank (1), the solution be pumped to filter press (9) by pump (8). At same time, polymer (additive) be flocculated in tank (6) and pumped to mixing pipe (21) on feeding pipe by pump (7) to membrane filter press (9)

At the end of filtration, in order to press the cake dryer, use pump (10) to pump high pressure water to inflate the membranes to get more filtrate.

After that, to pump acid from tank (12) to mixing pipe (13) to neutralize the left lime milk on filter cloths to clean them by water from pump (15) through washing device (14).

Dry filter cake be transferred by conveyor (16) directly to belt dryer (17) and then transferred them by conveyor belt (18) to storage site (19)

Whole system be operated automatically through Programmable Logic Control (PLC) (20)

NETZSCH also design cake discharge and filter cloths washing device (14) to open the frames, wash the cloths and re-pack the frames again to make the membrane filter press operated continuously.

2. General comparison of the three generation of NETZSCH filter press:

a. Plate and Frame Filter Press (1st generation):

- Working volume of this kind of press is around 50% as thickness of solid plate same as thickness of frame. Filtration pressure be designed up to 6 bar as maximum, so, the water content inside the cake still very high (always over 70%).
- Manual operation.
- Over 100 years design

b. Chamber Filter Press (2nd generation): (picture 5)

This type of filter can be overcome the main weakness of Plate and Frame Filter press by:

- * The solid plate be ream both sides in order to increase the working volume up to 70%
- * Filtration pressure be increased up to 16 bars or 32 bars
- * So, capacity of Chamber Filter Press be higher, filter cake be dryer (water content can be reduced to 35 – 50% depend on specification of slurry)
- * The frame size be designed up to 2000x2000 mm and automatically.

c. Membrane Filter Press (3rd generation): (picture 6)

In order to press the cake dryer and collect more juice, beside of using higher pressure $P_{\max} = 16$ bar or $P_{\max} = 32$ bar, there are the membranes what made by the special material for foodstuff as teflon, viton ... for the design from 800x800 mm upto 2000x2000 mm

After filtration, pumping the water with pressure over $p > 16$ bar to the clearance between plate and membrane made them bloat to the cake site, press them again to collect more juice what remained in cake. So, the juice remain in cake lower, from 20 to 35%

Membrane filter press has more advantage to chamber filter press:

- Filtration cycle shorter
- Collect more filtrate
- Dryer filter cake

(picture 7)

Membrane filter press with fully automatic design be installed in Cai Lan Oils and Fats Factory for separating sterine out of palm oil in the production of cooking oil.

3. Control of filtration by KoGri method:

- KoGri is one of the method to control pressure of filtration following the speed of feeding pump.
- Limit of filtration pressure must be lower than safety pressure of each type of material of filter plate – beside stainless steel – can be used polypropylene material (PP) to make the filter chamber for foodstuff. Durability of PP will be reduced when temperature of slurry increased. So, limit of filtration pressure of PP chambers depend on temperature of slurry to be filtered.

- Particular of NEMO feeding pump is progressive cavity pump with capacity be directly proportional to rotating speed of pump. It means the running speed is nearly proportional to the frequency of the power supply. This means that the flow rate is a nearly function of the frequency of the power supply to the motor. Therefore, the flowrate can be adjusted by adjusting the frequency.
- KoGri decrease the flowrate through the feeding pump over the time of filtration by decreasing the frequency of the power supply in steps, thus making sure that the maximum filtration pressure is not exceeded (picture 8)

4. Control of filtration by NEMO DOS 2 + NEMO Pump system:

- This is newest control system for filter press complete with NEMO pump of NETZSCH making sure separating process the two phases of solid and liquid by the combining of filter press operation and NEMO pump ideally most (picture 9)
- This ideal combination between NEMODOS2 controller with NEMO pumps designed by NETZSCH meet all requirements 100% even when delivering abrasive media.
- For the chamber filter press (2nd generation), please refer diagram at picture 10. For the membrane filter press (3rd generation) as in diagram at picture 11.
- A rapid increase in filtration pressure will cause the solids in the sludge to “blind” the filter cloths. This means that the solids in the flocculated sludge break down into smaller, finer particles that clogs the pores of the filter cloths. In order to prevent such problems, sludge feeding rate is controlled by adjusting the running speed of a Progressive Cavity Pump. There will be a gradual increase in filtration pressure to ensure that layers of solids are properly formed on the filter cloths and keep the mechanical stress on the particles within tolerable limits.
- The filtration pressure and the pump speed (frequency) are variable:

Variables:

Maximum pump speed	this will influence the cake build-up before reaching the start pressure
Start pressure	from this pressure on the control will take over
Step pressure	will be added to the present set pressure to calculate the new set pressure
Step holding time	the time the set pressure is maintained before advancing to the next set pressure
End pressure	the final set pressure, i.e. the highest achievable pressure
End holding time	the time the end pressure is maintained. Determines to a great extend the cake quality

- Typical sample data: (picture 12)

Max. speed	65 Hz
Start pressure:	1 bar
Step pressure	0.5 bar
Step holding time	180 sec
End pressure	10 bar
End holding time	300 sec

The NETZSCH 2nd and 3rd generation filter press be equipped with Programmable Logic Control (PLC), Frequency Invertor together with Pressure Gauge with Limit switches and control panel to control filtration actively.

The filter presses was supplied to the customers here in Vietnam as TICO Detergent, SAFOODSCO, Cai Lan Oils and Fats Factory, South Basic Chemical ... although 2nd or 3rd generation, all of presses be equipped this controller system and they still working well up to now.

NETZSCH aslo supply the filter press on mobile to serve at site periodical as the waste water treatment station (picture 12)

Conclusion:

NETZSCH is a private firm was establised since 1875 in Gemany who ‘s supplying of 4 main products as filtration, pump, grinding and dispersing (wet and dry) and thermal analysis.

NETZSCH with 60 offices around the world (Vietnam office is one of them) and many factories in Germany, United State, U.K, Belgium, Brazil and China

NETZSCH ‘s hounor to supply many equipment to Vietnamese customers as Bai Bang Paper since 1976 and upto now all of our four main products was be here in both North and South of Vietnam.