SUVIRON'S LOW RETENTION TIME CLARIFIER (SLRTC)

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Abstract:
For the separation of suspended solids like sand, clay, fibre escaped from mill house screening equipment there exist technologies like multitray clarifier having juice residence time around 120 to 180 minutes and low retention time clarifier (single tray) having juice residence time around 30 to 60 minutes.

Many sugar factories are using multitray clarifier, less sugar factories are using low retention time clarifier (single tray) and a few are using both type of clarifiers.

Drawbacks observed in multitray clarifier like higher retention time, temperature drop, higher inversion etc. are reduced to the maximum extent in low retention time clarifier.

This paper highlights technical details, advantages and comparison with existing system.

Keywords:
Multi tray, low retention time, clear juice, flocculent.

Introduction:

The Suviron's Low Retention Clarifier incorporating most modern and unique concept of peripheral feed launder and centrally located take off launder is designed to handle both, only limed as well as limed / sulphited cane juice for raw sugar manufacture or plantation white sugar manufacture respectively.

Technology:
In addition to basic design parameters of SLRTC for reducing the retention time it is equally essential that natural phenomenon of flocculation by way of bringing dispersed flocs together has to be artificially accelerated by adding higher molecular weight poly-electrolyte flocculent.

The quantity of poly electrolyte flocculent which is added for activating the flocculation process is hardly in few ppm. It is therefore essential that the fractional quantity of poly-electrolyte gets properly mixed with the incoming feed juice homogeneously allowing loose flocs to come together to form thick flocs heavy enough as required for achieving faster settling rate.

A certain specific time is required for accomplishing reaction kinetics of building up of flocs and it has been proved by experiments that the time of 2 – 2.5 minutes is required to complete flocculation activity. Preparation of polyelectrolyte solution of required concentration and its predetermined rate of dosing proportionate to juice flow rate also forms an essential part of the total system.

While desiring to achieve reduction in retention time i.e. with lesser working volume of the equipment very obviously cross currents and juice velocity inside clarifier should be decided more carefully as compared to conventional clarifier having retention time upto three hours. An essentially typical feature of SLRTC therefore is that it provides streamlined juice flow across the clarifier without any turbulence or cross flows.

A basic parameter defining capacity of SLRTC is the “initial rate of settling” of the solids. The up-flow rate (velocity) of the liquid must obviously be less than the settling rate of the solids at separation zone.

Loose bagasse has a sponge like natural tendency of absorbing air and water. During milling operation lot of atmospheric air gets mixed with extracted juice. Obviously the air being lighter than the juice has a tendency to rise upward to the open surface and thus counteracts the natural phenomenon of sedimentation by gravity which is a downward movement. Hence it is very essential to remove entrapped air prior to allowing the juice to enter the clarifier. Good amount of air gets dissolved into filtrate and ultimately into total juice going to clarifier during vacuum filter operation and more so during juice sulphitation process where compressed air containing 9-13% SO_2 v/v is injected.

Technical specifications:

Flash Tank:
All in carbon steel fabricated vertically mounted integral design improved flash tank having suitable vapour belt dia. is provided for removal of non condensable gases from feed juice by flashing prior to feeding to SLRTC. Vertically mounted cylindrical shaped having conical top and bottom improved flash tank is provided. The flash tank is of carbon steel welded construction fitted with vent pipe, juice inlet, juice outlet and manway and splash plate.

Incoming juice having temperature of 104- 105 Deg. C. enters at the side wall through feed inlet. By virtue of difference in temperature of incoming feed juice and boiling temperature at the prevailing atmospheric pressure air is released along with instantaneously flashing vapours through a sumptuously sized vent provided at the top of the tank. Juice outlet pipe from the bottom is connected to feed launder of SLRTC through a U bend provided for proper sealing between the flashed vapours and the liquid outlet and some extent to allow dampening effect. A drain connection with a sluice valve of suitable size is provided at the bottom most point of the outlet pipe. The drain pipe is terminated in the clarifier mud sump tank. The vent pipe is one meter long to be fitted at the top cone of the flash tank. In order to eliminate carryover of the juice particles from the flash tank a built in umbrella type catcher is provided. The polymer solution is added in the feed juice pipe of SLRTC after flashing.

Suviron's Low Retention Time Clarifier (SLRTC):
Carbon steel / stainless steel fabricated Suviron's Low Retention Time Clarifier having suitable diameter and liquid height complete with bottom single tray, shell and top cone along with following.

- Feed launder
- Mud thickener with mud thickener cone
- Clear juice liquidation valves
- Mud test cocks
- C.S. Sluice valve for mud outlet
- Concentrically located clear juice take-off launders
- Clear juice sump tank
- Mud test cock sump tank
- Perforated plate all across the clarifier – feed and takeoff zone

Drive for SLRTC:
Stirrer drive system complete with center tube, scrapper arms with tie rods, scrapper plates of trailing type design. Heavy duty drive head with planetary type gear box and electric motor assembly installed on bridge.

Specially designed free floating trailing type scrapers fitted to 4 nos. arms mounted on central rotating shaft, shall facilitate proper dragging of mud from bottom tray towards mud boot. The final speed of the stirrer shall be 4 RPH.

Installation of SLRTC:
The SLRTC is mounted on RCC / carbon steel fabricated structure at a pre-decided elevation so that muddy juice shall flow to muddy juice tank by gravity.

Polymer solution preparation cum storage tanks:
All in carbon steel / stainless steel fabricated two nos. polymer preparation cum holding tanks are provided. Polymer solution preparation cum holding tanks are designed to suit a usage period of 4 hours. Drain connection and outlet connection to polymer pumps are provided. Stirrer drive is provided for agitation. Delivery pipeline from pump to polymer addition point is provided.

For better results it is necessary to prepare the polymer solution using clean and clear hot / cold condensate water at approximate 40°C.

Bucket type strainers:
Bucket type strainers fitted with S.S. perforated basket are provided towards suction side of each dosing pump.

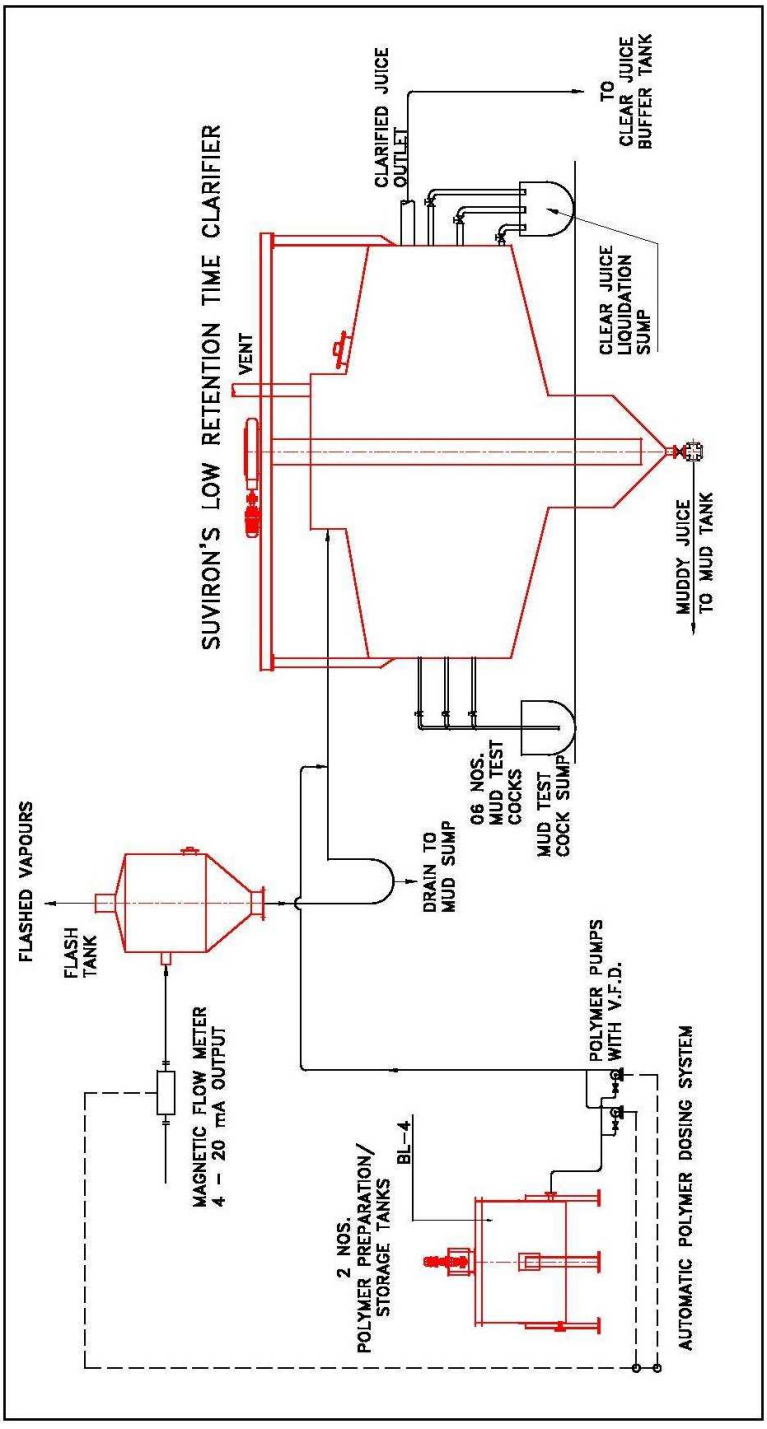
02 Nos. Polymer dosing pumps:
Polymer solution dosing pump with VFD electric motor mounted on common base frame are provided. One set in operation one as standby.

Piping and pipe fittings:
All integral piping and pipe fittings in carbon steel heavy duty quality.

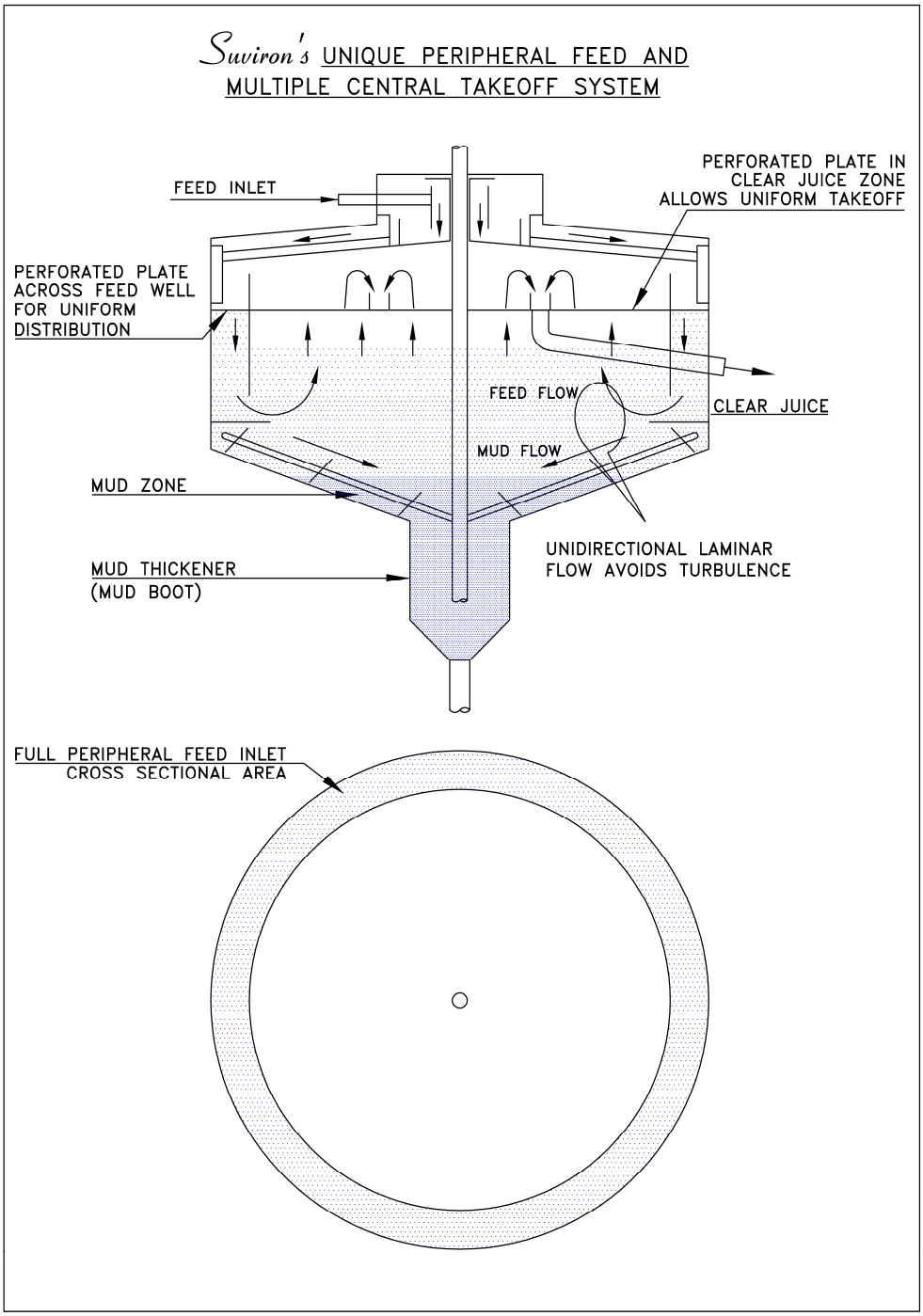
Electrical control panel:
One no. centralized control panel housing all controls and switch gears.

Automatic dosing of polymer – control philosophy:
Drive of polymer dosing pump is provided with VFD to receive signals in 4 – 20 mA. This dosing pump – motor - VFD receives signals from magnetic flow meter fitted in the feed juice - pump delivery pipeline so as to achieve precise dosing of polymer solution in proportion to the juice flow at a pre-set dosing value.

Process flow diagram of Suviron's Low Retention Time Clarifier



Juice flow pattern of Suviron's Low Retention Time Clarifier



Salient Features Of Suviron's Low Retention Time Clarifier

Retention Time: Good settling is achieved with less retention time. The retention time that depends upon "initial rate of settling" varies between 45-55 minutes according to processing parameters and maximum removal of fibre from mixed juice.

Suspended particles: Brilliant clear juice free from any suspended solids.

Sucrose inversion loss: Less retention time hence less risk of sucrose inversion loss.

Temperature drop: Less temperature drop of only 2 to 3 degree C. due to less heat exposed area.

Mud consistency: Compact mud formation for achieving better vacuum filter/decanter performance.

Colour of clear juice: Less risk of new colouring matter formation due to reduced risk of heat exposure.

Turbidity of clear juice: 5 – 10 IU for sulphitation plant and 15 – 20 IU for defecation plant depending upon operational techniques and maximum removal of fibre from mixed juice.

Simple maintenance: Simple in maintenance – e.g. mud outlet valve is "the only" valve required in regular operation. No sealing rings around central shaft. There is only one set of scraper having four arms each fitted with multiple scrapper plates on one single tray for mud scraping.

Optimum settling aid polymer: Optimum consumption of polymer flocculent achieved by its homogeneous mixing with juice prior to feed launder. The cost involved in polymer addition is affordable and quite economical considering the multifold advantages gained.

Wide range of application: Wide range of application for clarification of cane juice, secondary juice, filtrate juice, sweet sorghum juice and beet juice; as already being practiced at various sugar factories.

Foundation and building cost: Due to less juice load and self-weight of low retention time clarifier the cost of foundation is comparatively less. Outdoor installation is rather recommended in this case as there is no any particular operation or attention required around clarifier. Therefore the cost on account of building is totally avoided.

Photograph of SLRT clarifier

Clear Juice Sample

Comparison between Conventional multi-tray clarifier and Suviron's Low retention time clarifier considering same juice clarification process

Sr. No.	Parameter	Conventional Multi-tray Clarifier	Suviron's Low Retention Time Clarifier
1	pH of feed juice	7.0 and above	7.0 and above
2	Retention time at rated capacity	150 to 180 minutes	45 to 55 minutes
3	No of trays / compartments	4 or 5	Single
4	Juice entry	Feed juice enters at flocculation chamber and passes through centre tube of clarifier	Feed juice enters at feed launder and passes towards peripherally located feed well through juice distributing pipes
5	Mud travel with respect to juice flow direction	Flow opposite to each other likely to cause intermixing of flocs with clear juice	Unidirectional streamlined flow of both fluids
6	Liquidation time	Around 90 min.	Around 30 min.
7	No of valves	Around 28 to 35	Around 6
8	Inversion loss	Due to higher retention time more inversion occurs.	Due to less retention time less inversion occurs.
9	pH drop	Due to higher retention time and 4 or 5 mud / clear juice interfaces more pH drop occurs.	Due to less retention time and only single mud / clear juice interface less pH drop occurs.
10	Muddy juice consistency	1030 to 1040 grm per lit	1040 to 1060 grm per lit
11	Temperature drop	4 to 6 deg. C	2 to 3 deg. C

Conclusion:
In view of multiple advantages low retention time juice clarifiers are gaining edge over conventional multi-tray clarifier. Suviron's Low Retention Time Clarifier offers a unique technology of peripheral juice feeding and concentric clear juice take off launders ensuring best performance results across clarifier station.

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