PERFORMANCE OF A LOUISIANA LOW TURBULENCE (LLT) JUICE CLARIFIER

By

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The Andhra Sugars Ltd. INDIA 534 215

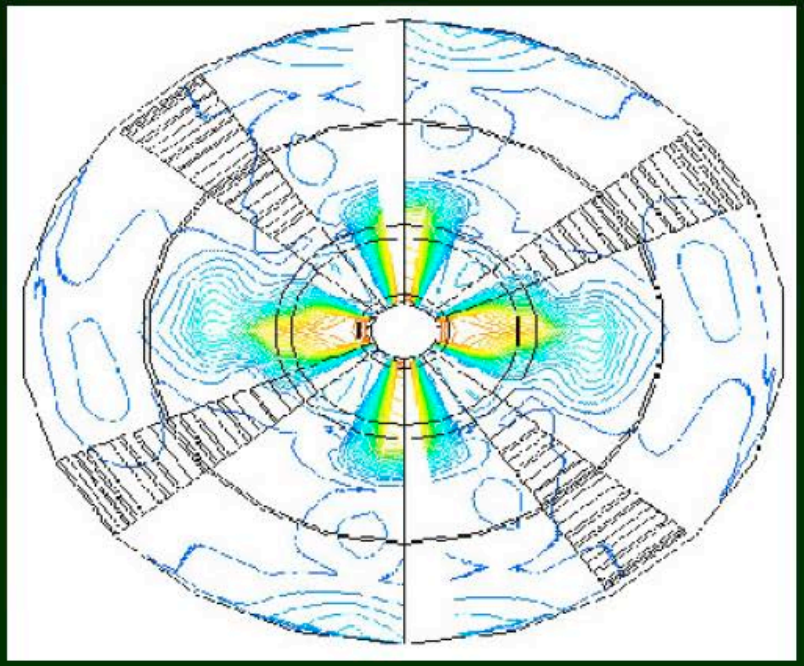
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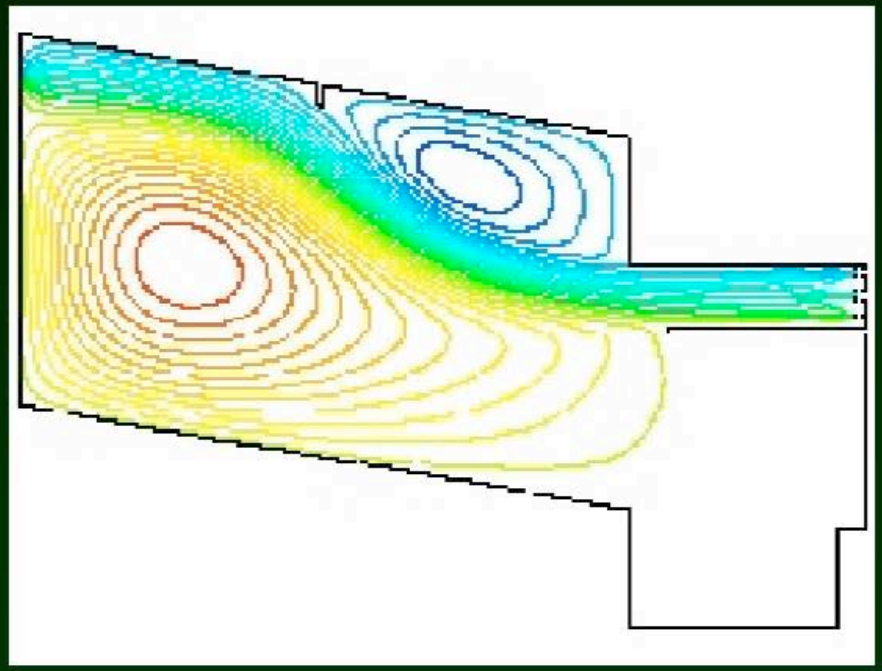
- Juice clarification is an important operation at a cane sugar plant.
- For many decades Multi Tray Clarifiers that have a retention time of 2 to 2 ½ hours have been used.
- These are now slowly being replaced by Short Retention Time Clarifiers that have a retention time of 30 to 40 minutes, but use more flocculant.

- At 2 of the Andhra Sugars Ltd. plants Graver & Dorr type juice clarifiers were replaced by SRI New Generation (SRI-NG) juice clarifiers that brought down the retention time considerably. A Graver type still operates at the 3rd sugar plant.

- A visit to the Sterling Sugar's cane sugar plant in Louisiana, USA, gave an opportunity to see the Louisiana Low Turbulence (LLT) juice clarifier.
- Performance of the LLT clarifier at this plant was quite good compared to SRT clarifiers.
- So it was decided to use the shell of an unused clarifier at the 3rd sugar plant, retrofit it with Turbulence Reducing Devices and operate it in tandem with a Graver juice clarifier. This gave good results.

Large Scale Turbulent Eddies in an Industrial Clarifier





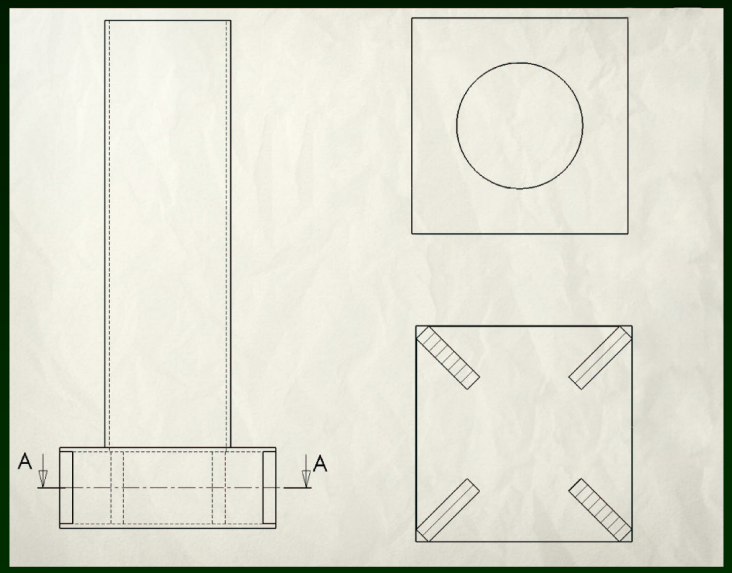
Rapidorr 444
CFD Modeling
Chetty and Davis, 2001

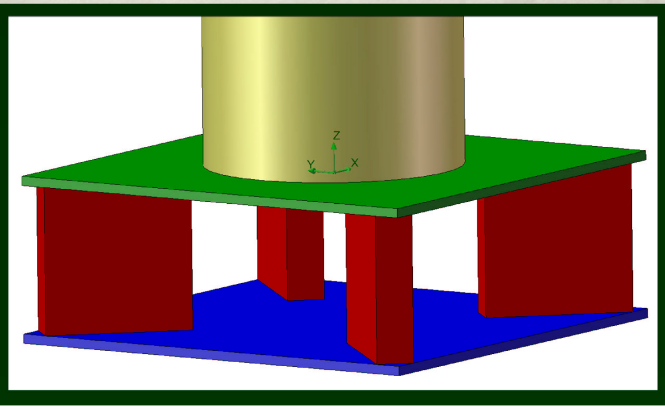
Courtesy Dr.Vadim Kochergin

Design Concepts

- Large scale turbulent eddies created by juice introduction need to be reduced.
- Velocity in the feed channels should remain relatively high to eliminate plugging/scaling.
- Uniform distribution of feed inlets and outlets to warrant even vertical juice velocities and to make full use of the cross-sectional area of the clarifier.
- Minimize any non-vertical flows within a clarifier.

Turbulence Reduction Device - First Trials



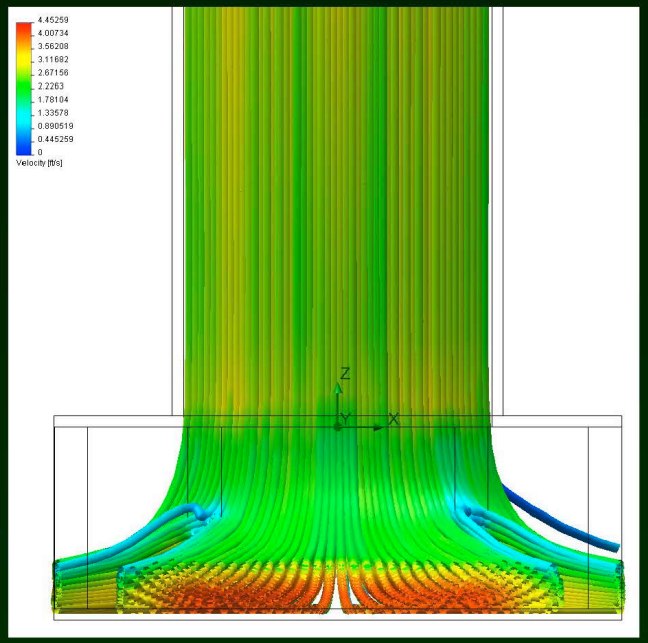


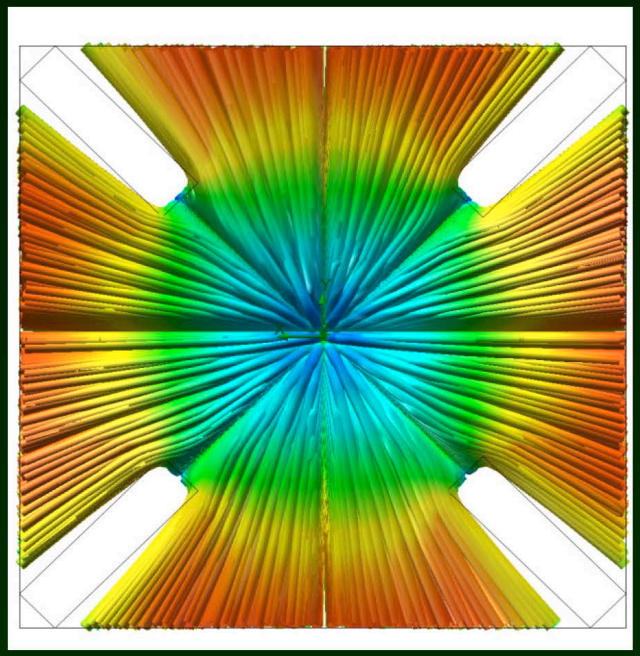
Design Parameters:

- Flow rate: 100 gpm
- Viscosity: 1.5 cp



Courtesy Dr.Vadim Kochergin

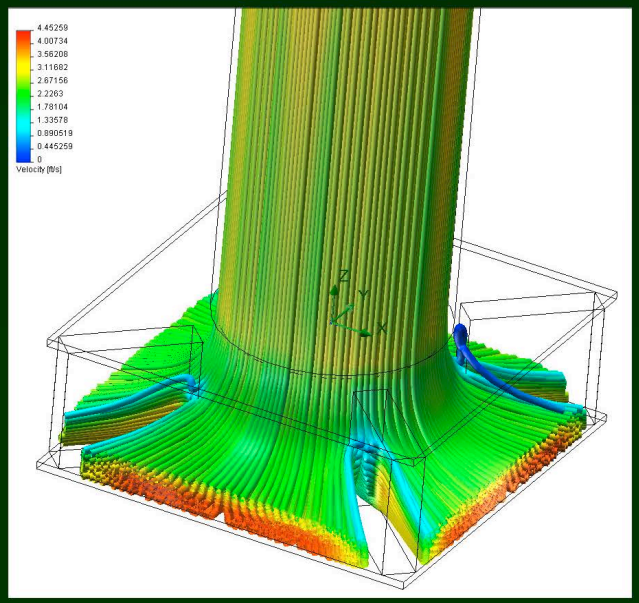




Average flow velocity at pipe inlet: 3.335 ft/s

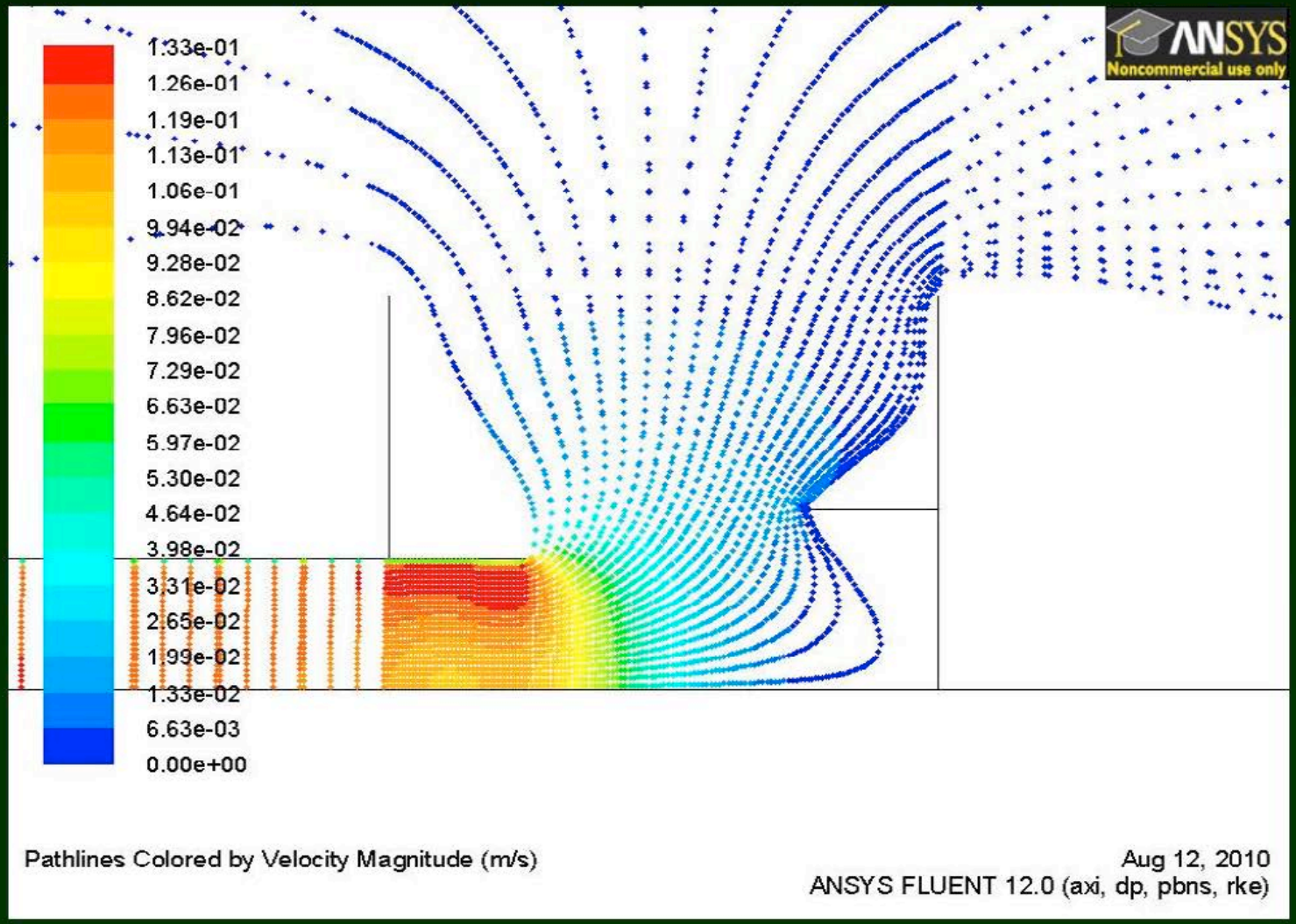
Max velocity at outlet of guide vanes: 4.45 ft/s

Small eddying/circulation occurs at outlet of guide vanes (blue arrows flow in)

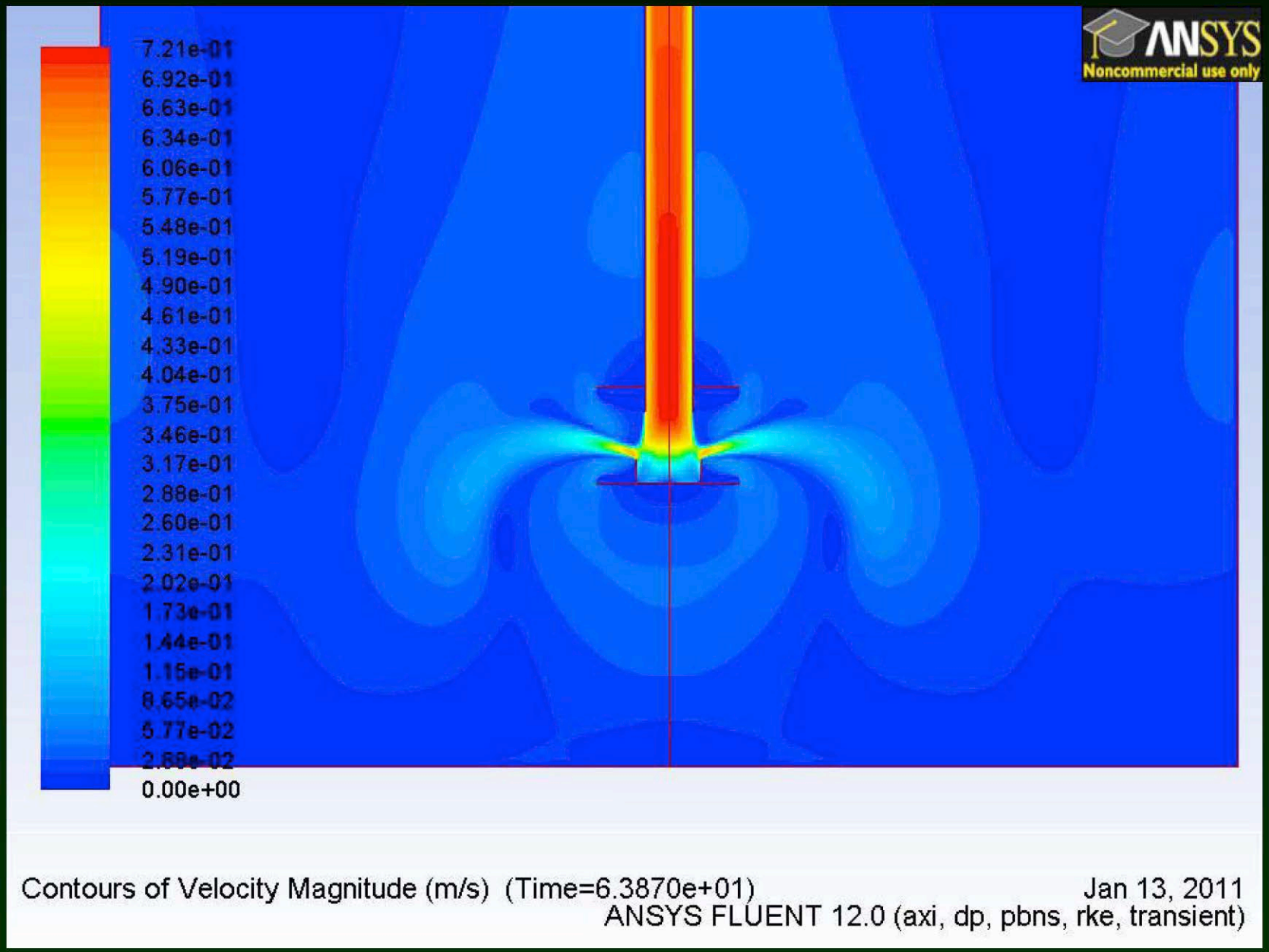


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Velocity Pathlines- Modified Design

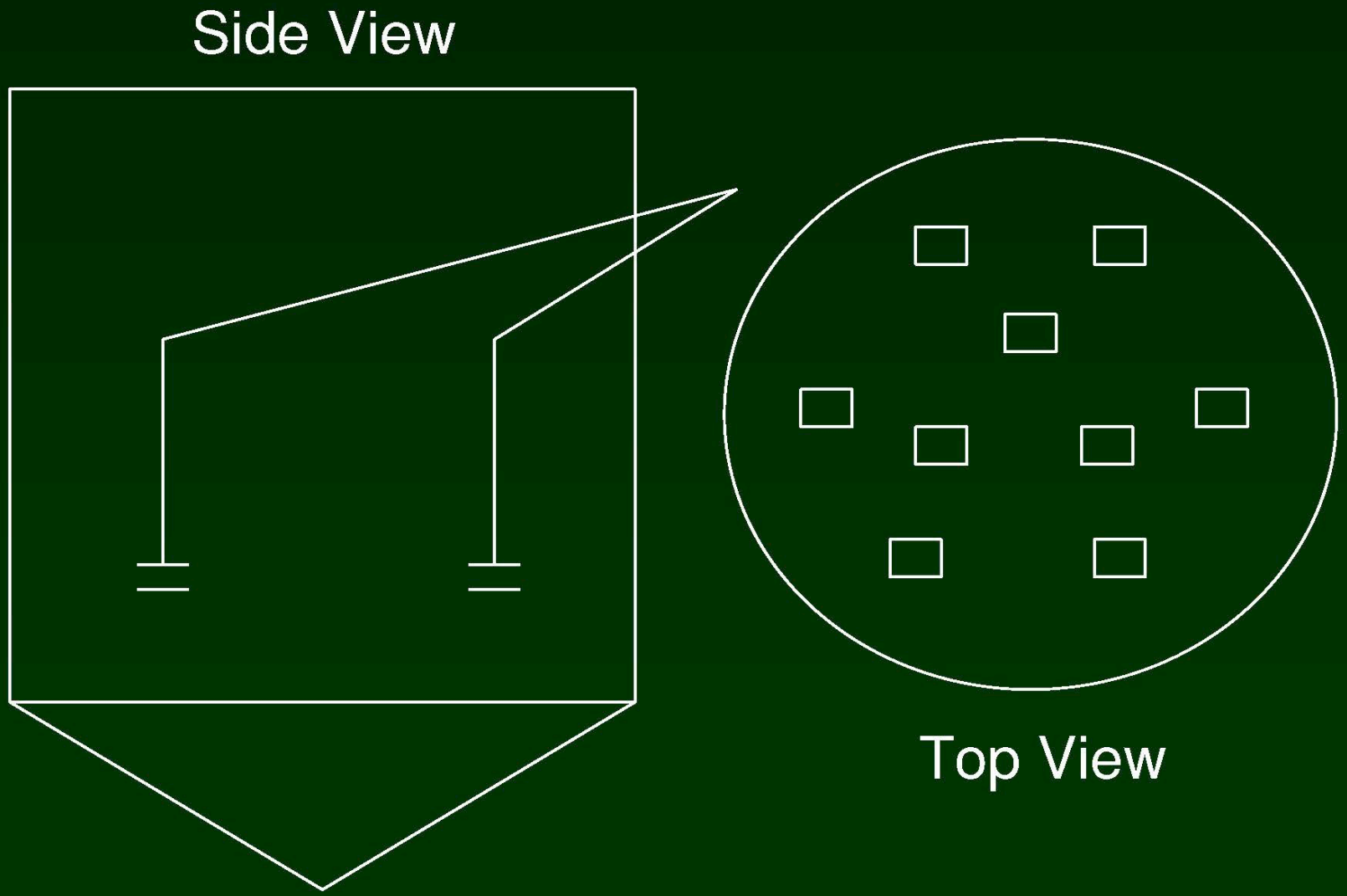


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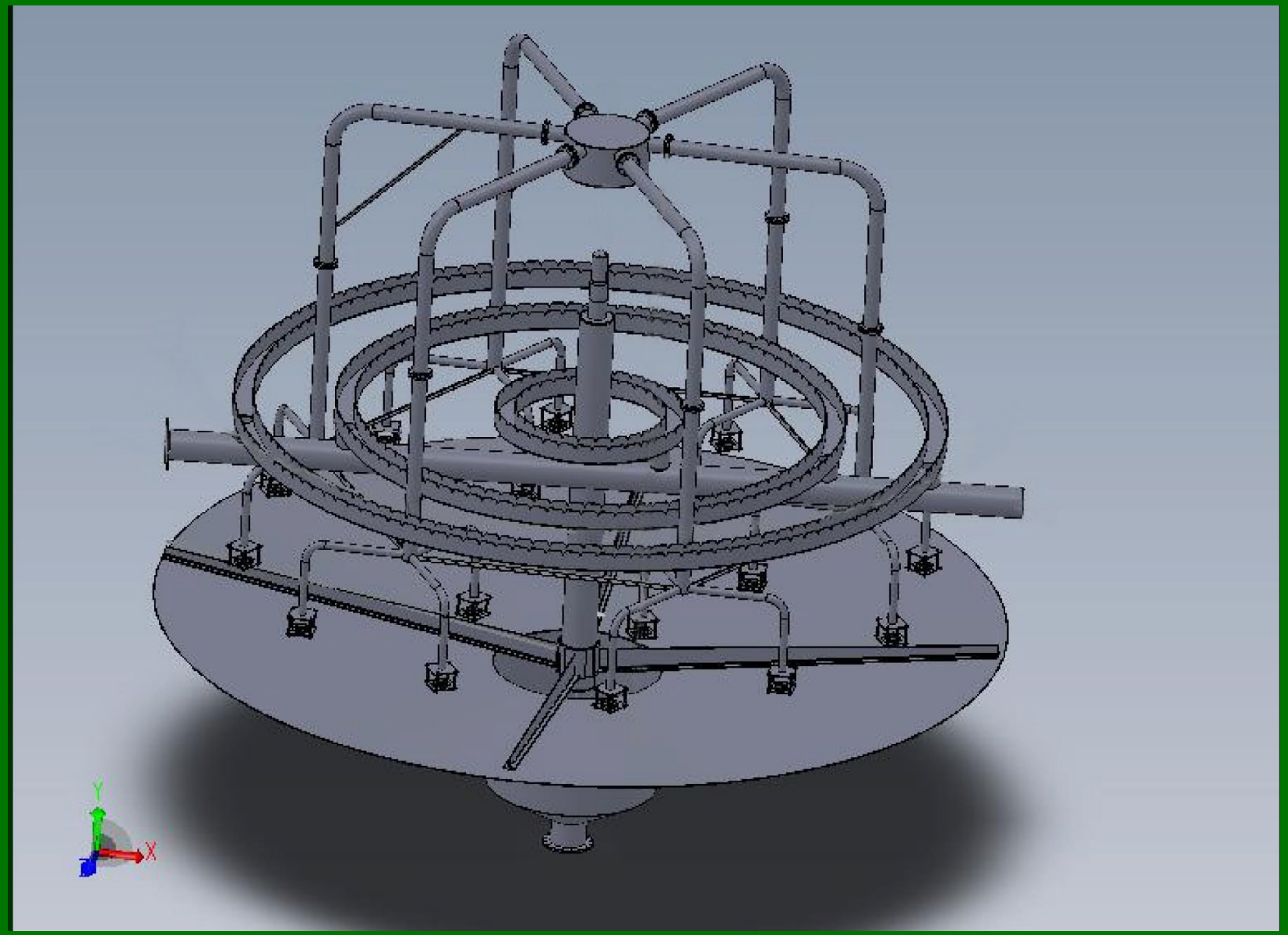
Courtesy Dr.Vadim Kochergin

Basic TRD Layout



Courtesy Dr.Vadim Kochergin

Clarifier Retrofit

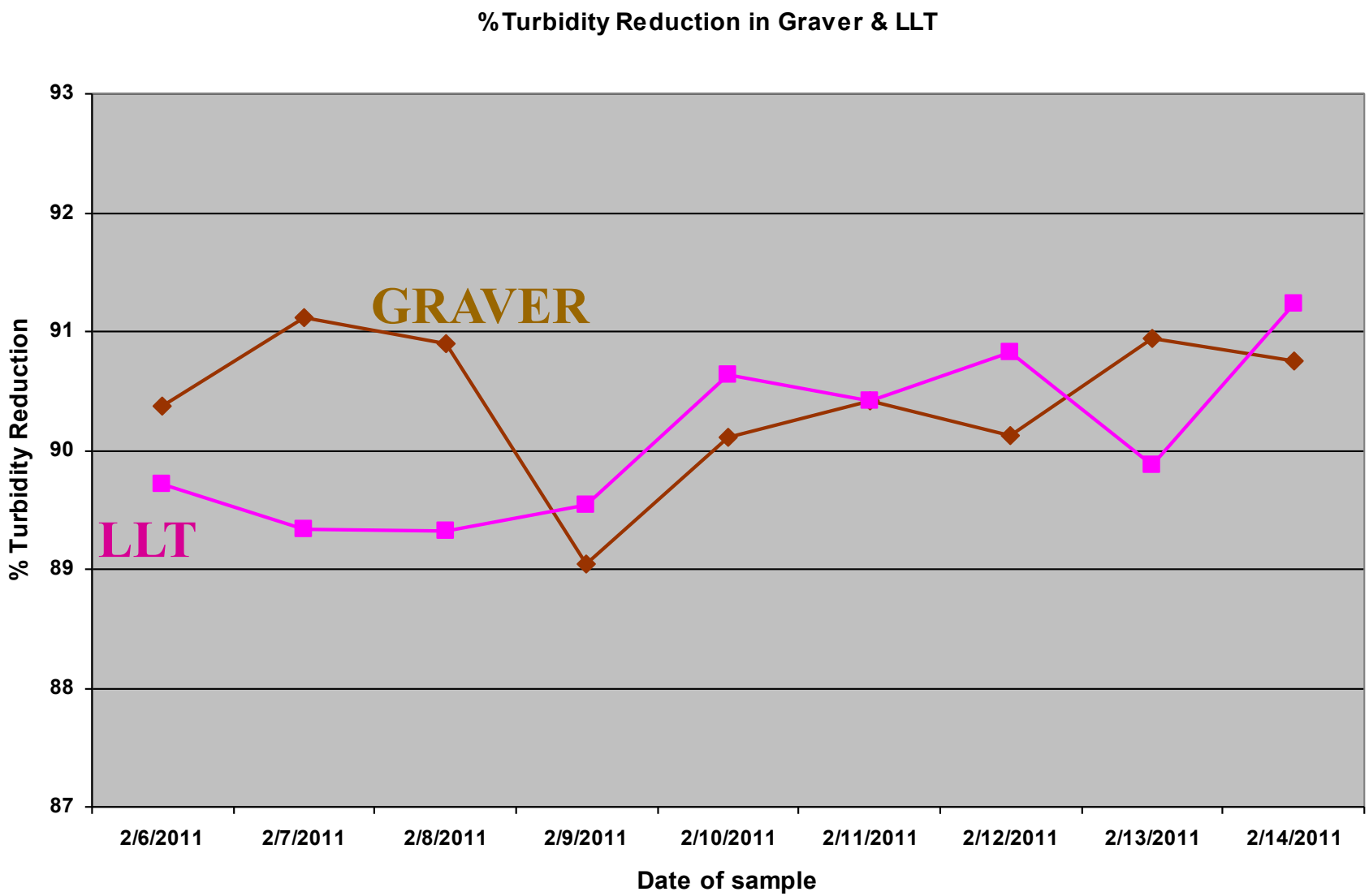


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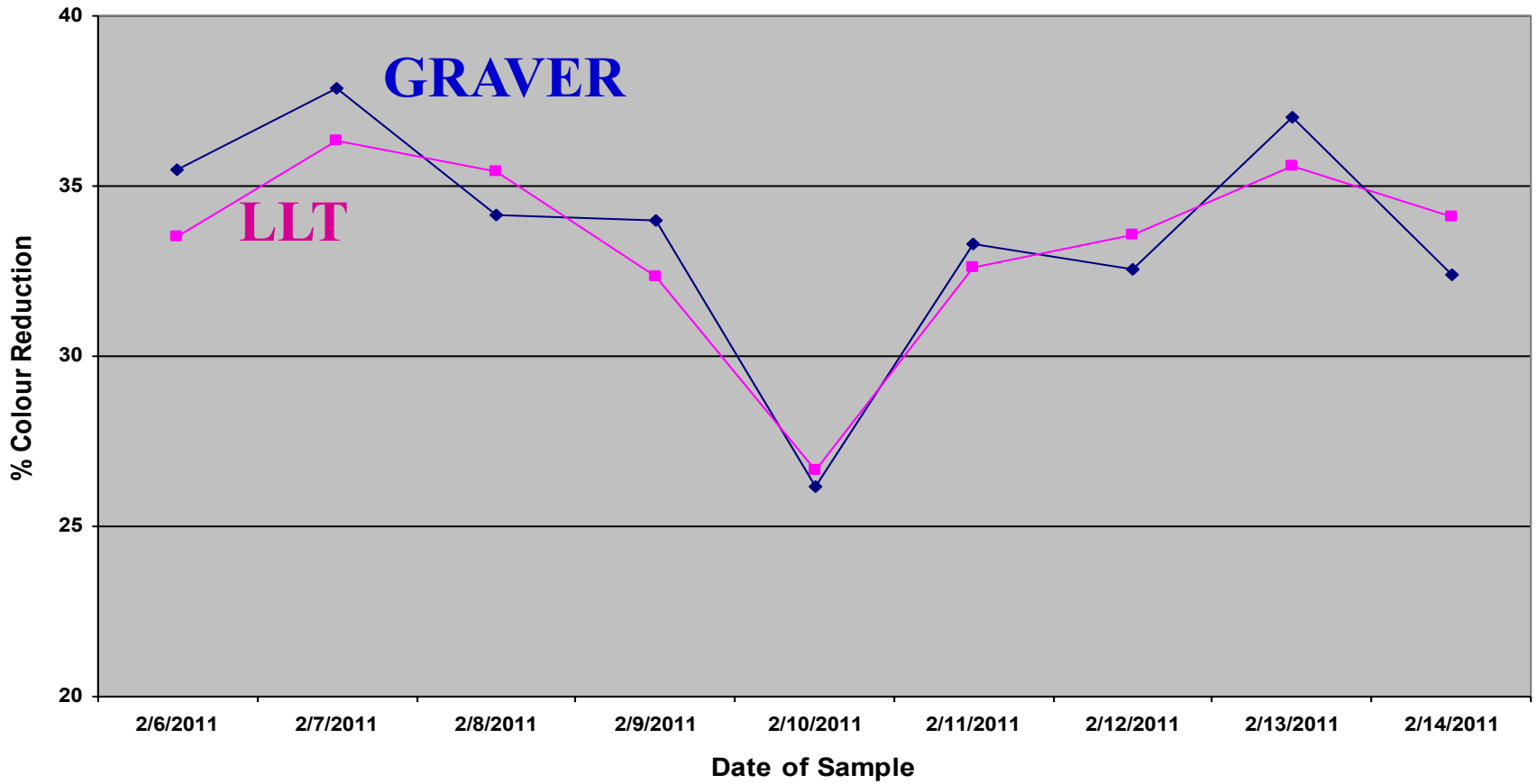
Comparison LLT and Graver

- Both clarifiers were operated in parallel, with streams from the same juice.
- Colour, turbidity and retention times were measured.
- The comparison was done over the period 6th to 14th February 2011.
- Daily composites were used.

% Turbidity Reduction in Graver & LLT Juice Clarifiers



% Colour Reduction in Graver & LLT Juice Clarifiers



- Performance data of both clarifiers as observed at the same flow rate showed that while the Graver clarifier had a retention time of 135 minutes, the LLT clarifier had a retention time of 37 minutes.

Based on these retention times, inversion was estimated in each clarifier by using Fig. 25.4 and Table 25.2 of Cane Sugar Engineering (P W Rein).

The results indicated that reduced inversion in the LLT clarifier would save about US$ 20000 per 100000 tons cane crushed.

Cost comparison of Graver, SRI-NG & LLT Clarifiers

Sl. No.	Description	Graver	SRI - NG	LLT
1.	Handling capacity in TCD	6000	6000	6000
2.	Size in meters	Ø 10.5 X 8.0 Ht	Ø 8.5 X 4.0 Ht	Ø 8.5 X 3.25 Ht
3.	Retention time in minutes	135	45	37
4.	Total weight in kgs.	72000	39000	26000
5.	Total cost including foundation in USD	164500	158000	72500

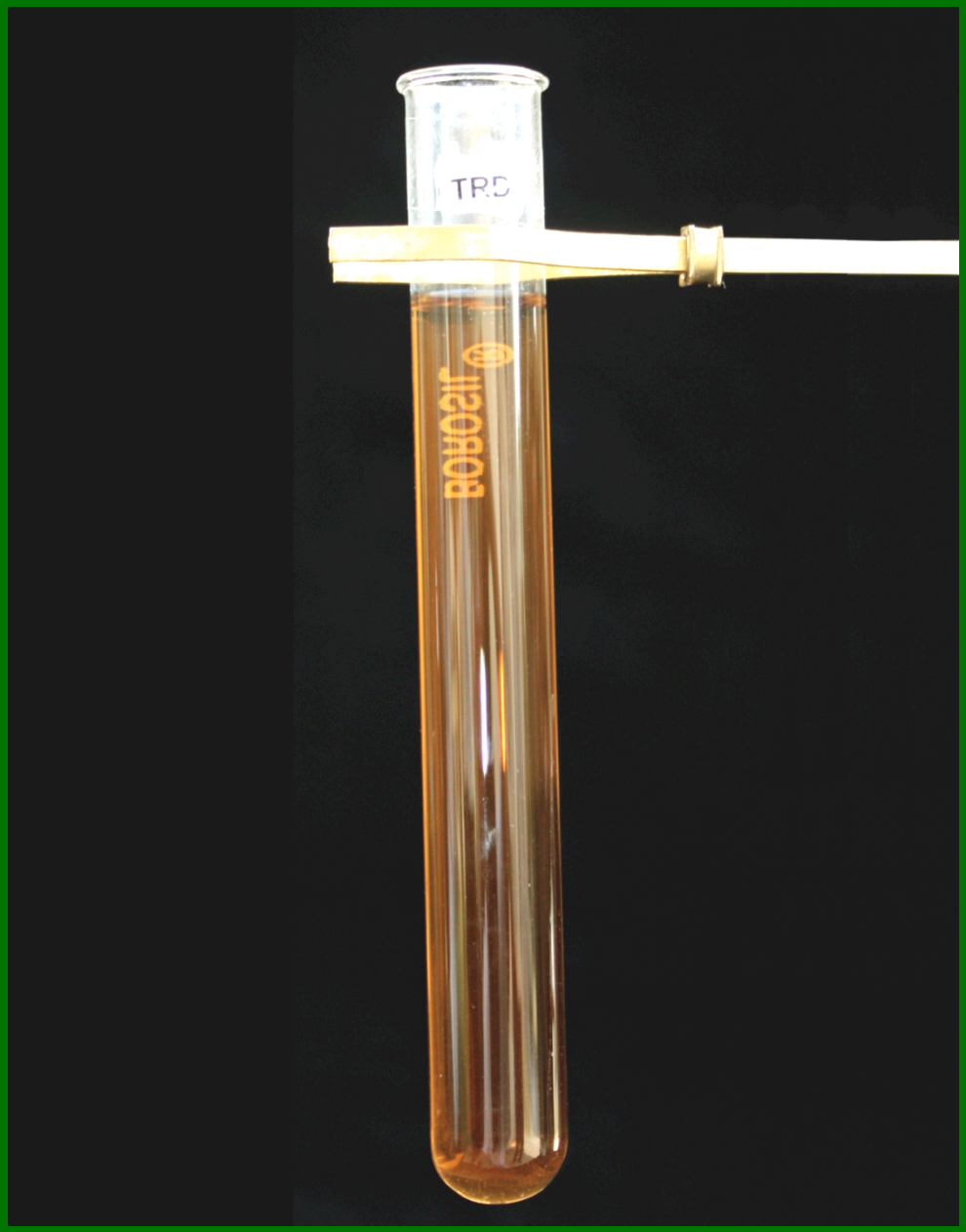
- The cost to build a LLT clarifier is 56% lower than a Graver clarifier and 54% lower than a SRI New Generation Clarifier.

- The temperature of juice out of the LLT clarifier was 3^0C higher than that out of the Graver clarifier, resulting in a bagasse saving of 1300 metric tons, for a crush of 500000 metric tons of cane.



1 2 3

1. Diffuser Juice
2. Limed & Sulphited Juice
3. Clear Juice



Clear Juice from the LLT Juice Clarifier

Future work

With this performance of the LLT clarifier, the Graver clarifier at the 3rd sugar plant will be retrofitted with turbulence reduction devices and converted to a LLT clarifier during the 2011 off crop.


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