

# Ion Exchange Decolorization Applications Using Fractal Shallow Bed Equipment

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# Applicability of Available Information And Challenges For Beet Sugar

## Applications

- Most information is about low color (less than a 1000 IU) cane syrups
- Resin bed depth – 6-13 feet( flowrates, pressure drop issues)
- Irreversible fouling with high MW colorants( the composition is different for beet extract / thick juice)
- Amount of regenerant waste is proportional to color removal ( high color syrups will generate larger amount of waste- needs to be addressed)
- Different pH, Brix, etc.

Old style equipment is expensive, new approaches required

# Group Consortium Trials

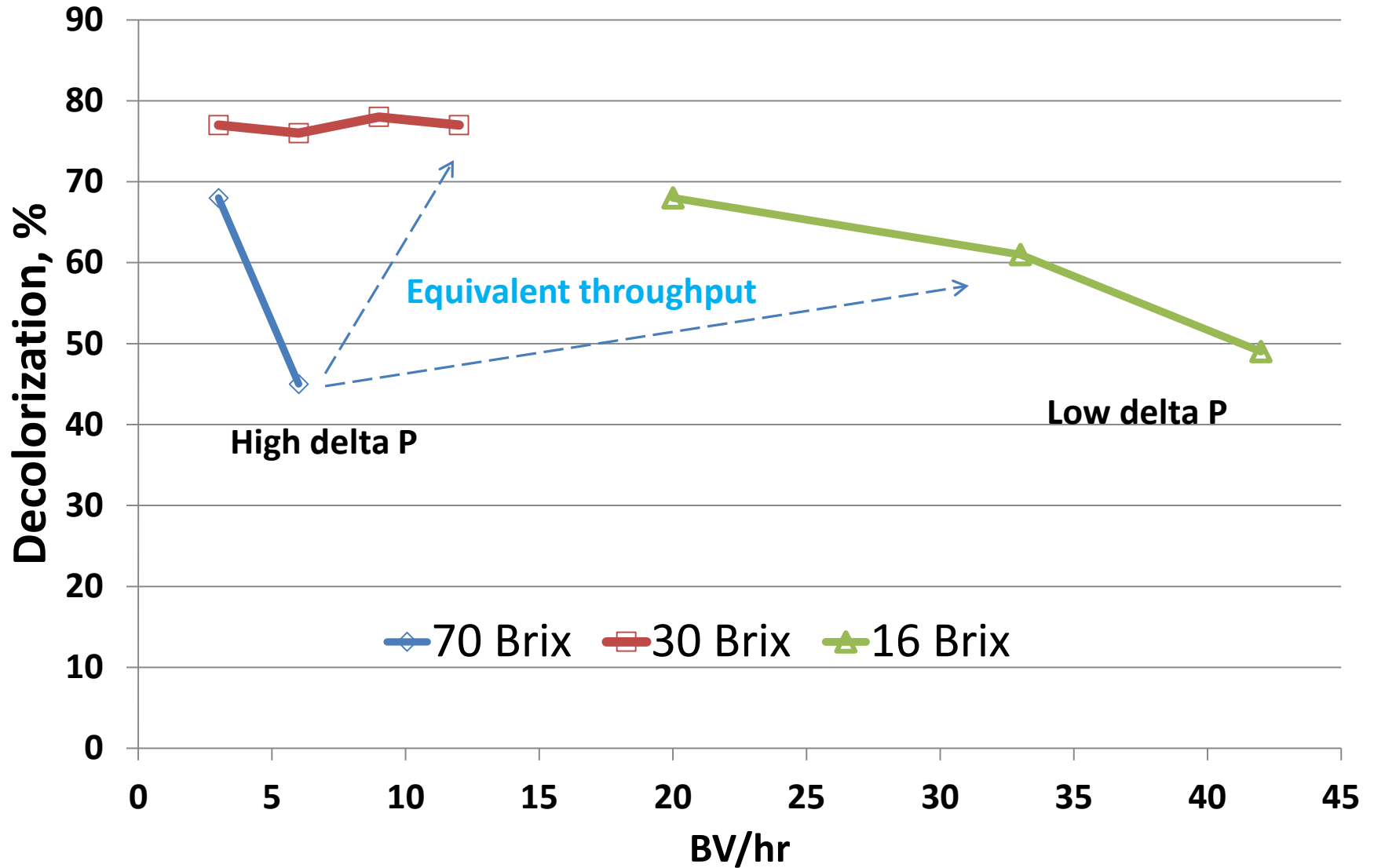
- Amalgamated Sugar
- American Crystal
- Michigan Sugar
- Rogers Sugar

# Pilot Equipment



# Effect of Brix on Decolorization

( 30 and 70 BX extract, 16 Bx Thin Juice - 3 ft resin bed )



# Study Highlights

- Decolorization can be accomplished in relatively short beds that minimizes the capital investment
- Decolorization on dilute juices is more efficient. Additionally, the overall resin loading is higher due to accessibility of resin active sites
- As a result, the amount of regenerant can be reduced. Regenerant use can be optimized by partial recycle and nanofiltration
- Regeneration can be accomplished at higher flowrates
- Fractal Shallow Bed equipment design allow to bring both capital and operating cost to a reasonable level

# Escon / ARi Fractal Shallow Bed Softener Installation In a European Sugar Plant



# Two Consecutive White Boilings in the Beet Sugar Industry

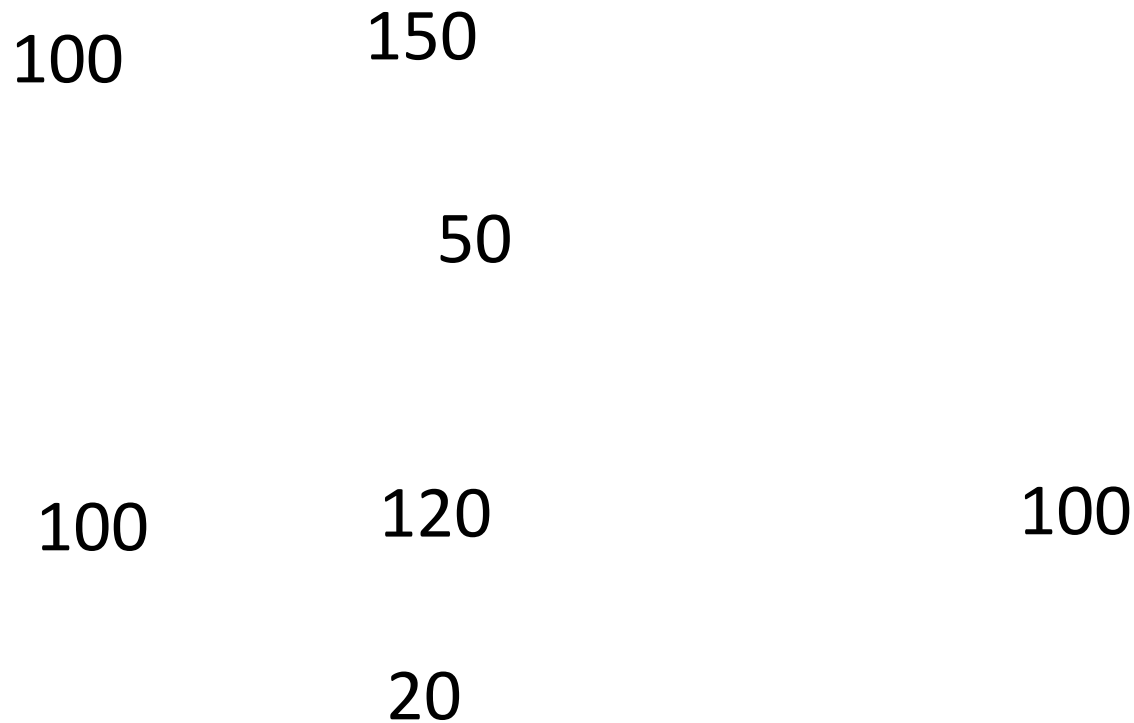
Underlying Concept -  
Reduce Negative Impact of  
Recycles



# Reasons for Recycle

- Higher product recovery
- Improved quality of the product ,
- Minimized environmental impact through the reduction waste streams
- Improved heat recovery
- Etc.

# Effect of Recycle on Sugar Inventory



Recycles Require Larger Equipment

# Sugars™ Estimates for Two White Boilings

		White		High Raw		Low Raw
Parameter	Existing	Two White Products	Existing	Two White Products	Existing	Two White Products
M/Cuite Flow (cu. ft./hr)	<b>2,286</b>	<b>1,672</b>	<b>1,089</b>	<b>785</b>	<b>462</b>	<b>473</b>
% Sugar Recycle	<b>42.1</b>	<b>18.3%</b>				
Sugar Color (ICUMSA)	<b>23</b>	<b>17</b>	<b>2855</b>	<b>34</b>	<b>7444</b>	<b>3817</b>
Pan Purity (%Sug/DS)	<b>94.0</b>	<b>93.1</b>	<b>87.7</b>	<b>85.4</b>	<b>76.3</b>	<b>76.8</b>
Molasses Purity (%Sug/DS)					<b>59.1</b>	<b>59.4</b>
Steam Flow (lb/hr)	<b>50,305</b>	<b>52,843</b>	<b>20,786</b>	<b>10,145</b>	<b>6,789</b>	<b>5,869</b>
Molasses Color (ICUMSA)					<b>43,778</b>	<b>22,442</b>

# Estimated Percent Reduction

Total massecuite Flow	24
Percent of Sugar Recycle	57
Exhaust steam usage	12
Molasses color	49

Flowrate, BV/hr	Bed length Ft.	Cycle length, min	Average Feed Color, ICUMSA	Color Removal. %	Color Loading, units/l resin
20	2	360	1,370	61	15,820
33	2	360	1,513	63	21,999
42	2	420	1,733	49	35,514
30	3	360	1,280	68	15,224
36	3	300	1,302	63	18,186

# Remaining Questions for Large Scale Trials

- Ash content and crystal size in the second boiling
- Variability of thin juice color during the crop
- New purity profile with two white products
- Utilization of continuous machines be used after the second boiling ( crystal uniformity )
- Longer term resin studies (regenerations efficiency and sustainability, etc.)

# Conclusions

- Decolorization with Fractal Shallow Bed Approach makes projects more attractive due to lower capital and operating cost
- Use of innovative technologies and approaches is required to support the new vision

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