



# Improvement of Plantation White Sugar Quality for Asian Market

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- Plantation white sugars specifications
- Limitations of “plantation white sugars” production
- Refining Process with Ion Exchange decolorization
- Reducing the environmental impact of the decolorization
- Alternative Refining process for small capacities
- Liquid Sugar Benefits & Liquid Sugar Process integrated to sugar refinery
- Alternative Liquid sugar process starting from plantation whites
- Conclusions



## GB 3017-2006

	White sugar grades			
	refined sugar	superior	grade 1	grade 2
surcose content, % $\geq$	99.8	99.7	99.6	99.5
reducing sugar content, % $\leq$	0.03	0.04	0.1	0.15
conductivity ash content, % $\leq$	0.02	0.04	0.1	0.13
loss on drying, % $\leq$	0.05	0.06	0.07	0.1
color value, IU $\leq$	25	60	150	240
turbidity / MAU $\leq$	30	80	160	220
insoluble impurity , mg/kg $\leq$	10	20	40	60
SO <sub>2</sub> , $\leq$	6	15	30	30
As, $\leq$	0.5	0.5	0.5	0.5
Pb, $\leq$	0.5	0.5	0.5	0.5
Cu, $\leq$	2	2	2	2
bacterial colony, number/gram	100	100	100	100
coliform, MPN/100g $\leq$	30	30	30	30
saccharomycetes, cfu/g $\leq$	10	10	10	10

**White Sugar of grade 1 and grade 2 are obtained directly at the mill by (double) sulfitation process**

## “Plantation White “ sugar production

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In “plantation white cane sugar” production, **sulfur dioxide is bubbled through the cane juice and syrup; this chemical bleaches many color-forming impurities into colorless ones.** Sugar bleached white by this sulfitation process is called "plantation white“. This form of sugar is the form most commonly consumed in China and others places of Asia

Issues associated with sulfitation:

Sugar quality

High SO<sub>2</sub> content

High Ash content

Floc test can not be passed

Corrosion in sugar factory equipment

Emission of SO<sub>2</sub> fumes, detrimental for environment

## Advanced technologies for cane sugar production

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Cross-flow membrane filtration and ion-exchange technologies have been developed for improving sugar production from cane:

- Production of VHP cane raw sugar at the cane mill, without sulfitation
- Optimized integration for production of refined sugar at the cane sugar mill
- Ion-exchange decolorization for cane raw sugar refineries
- Direct production of high grade liquid sugar for local industrial markets

# Production of VHP Cane Raw Sugar at the Cane Mill

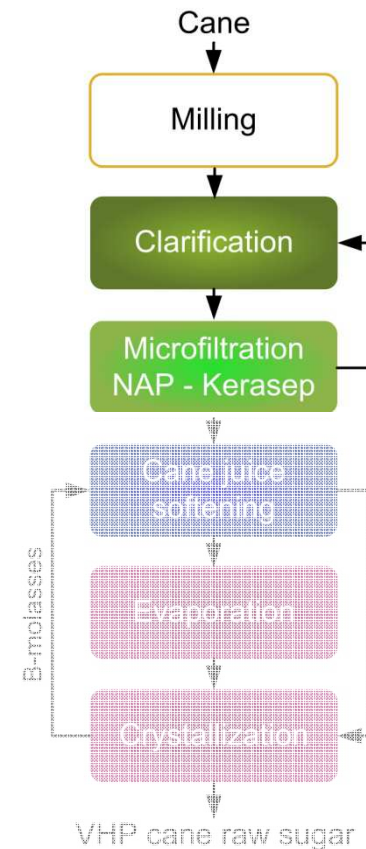
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# Production of VHP Cane Raw Sugar

- Very soon, about 80% of the saccharose produced worldwide will be from cane
- Novasep has developed NAP microfiltration processes

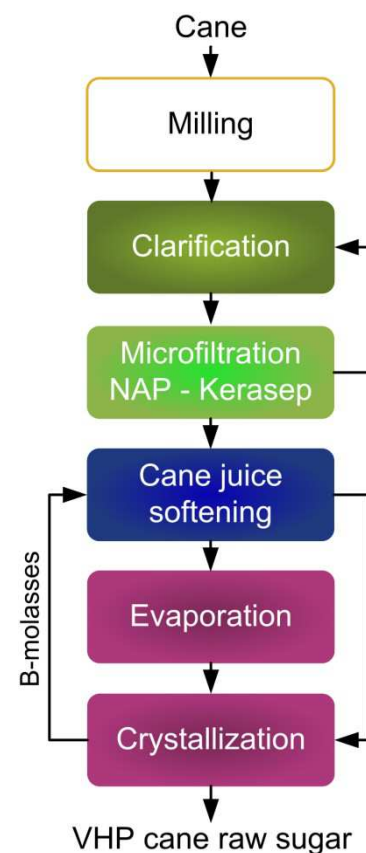
## New Applexion® Processes

- Production of higher quality sugar
- Production directly at the mill
- Cost-effective solution
  - Savings in CAPEX
  - Savings in OPEX



## Production of VHP Cane Raw Sugar

- Production of « NAP sugar » or VHP (**Very High Polarization**) cane raw sugar, without sulfitation:
  - 40% less color
  - 55% less ash
  - 20% higher crystallization speed
  
- VHP cane raw sugar:
  - Easy transformation into refined sugar directly at the mill
  - Sale to refineries at a premium
  
- Concentration of microfiltered and soft cane juice in most efficient evaporators:
  - Reduced energy usage
  - More bagasse available for co-generation





# Cane Sugar Refining

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# Sugar refining

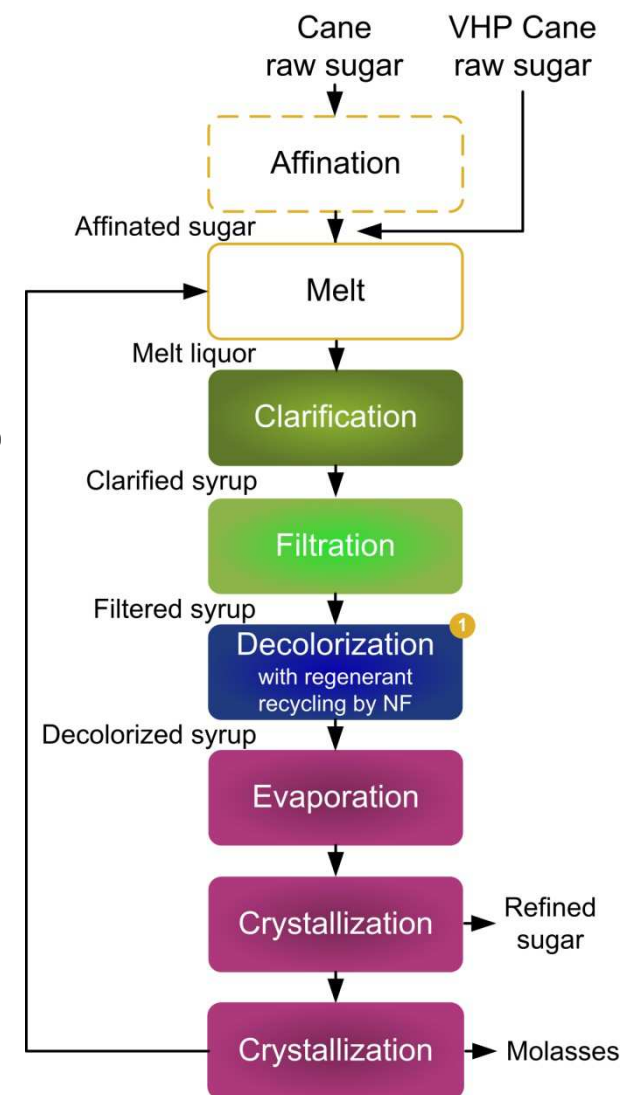
Sugar refining can be used to produce refined sugar from raw sugar obtained without sulfitation process, hence suppressing the issues associated with sulfitation.

In sugar refining, raw sugar (of brown color) is further purified. It is first affinated : mixed with heavy syrup and then centrifuged clean, then dissolved to make a syrup, about 65 % DS.

The sugar solution is clarified by liming / carbonation/filtration.

The clarified syrup is decolorized by ion Exchange process.

The purified syrup is then concentrated to supersaturation and repeatedly crystallized under vacuum, to produce white refined sugar.

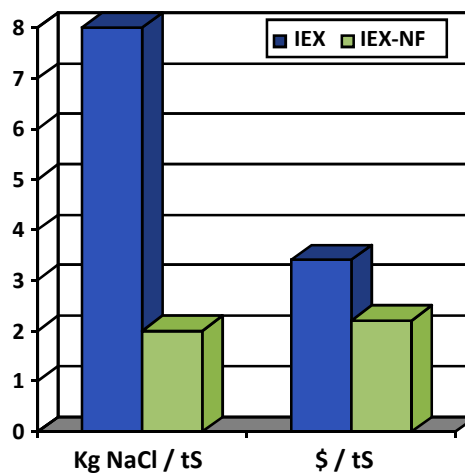
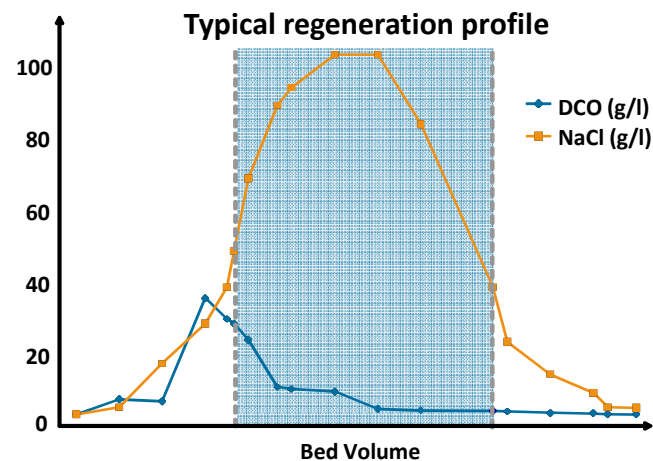
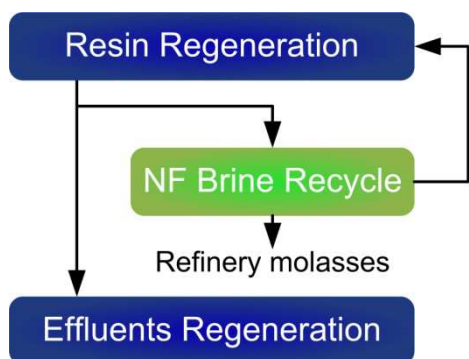


# Decolorization in Cane Sugar Refineries

- Decolorization is one of the most critical steps and consists of removing color from:
  - Polyphenols, initially present in cane and caramel
  - Melanoidins
  - Products from hexose degradation
- Optimized ion-exchange decolorization system
  - Innovative regeneration process options
  - Optimization of CAPEX vs. OPEX strategy
  - Low consumption of regenerant
  - Reduction of the quantity of effluents

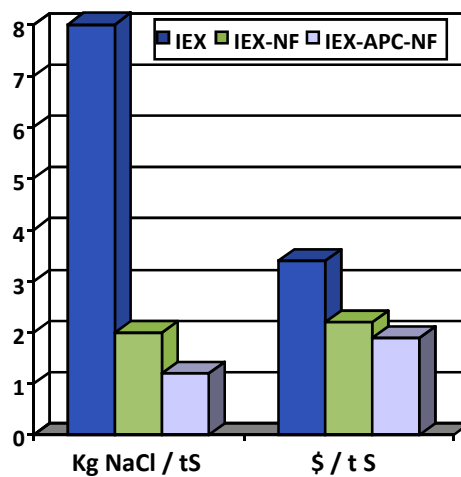
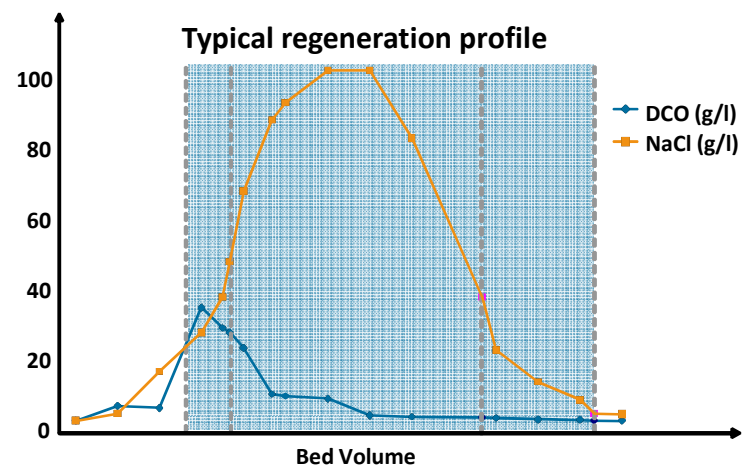
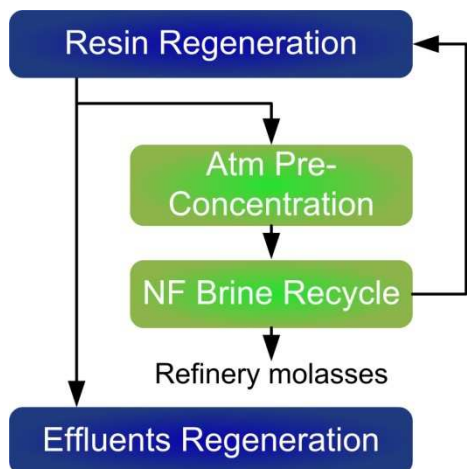


# Nanofiltration Brine Recovery System



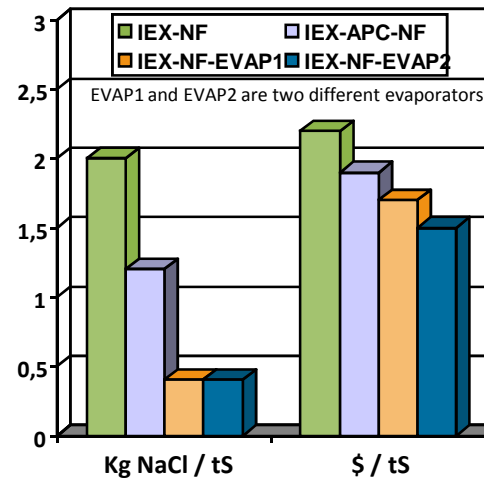
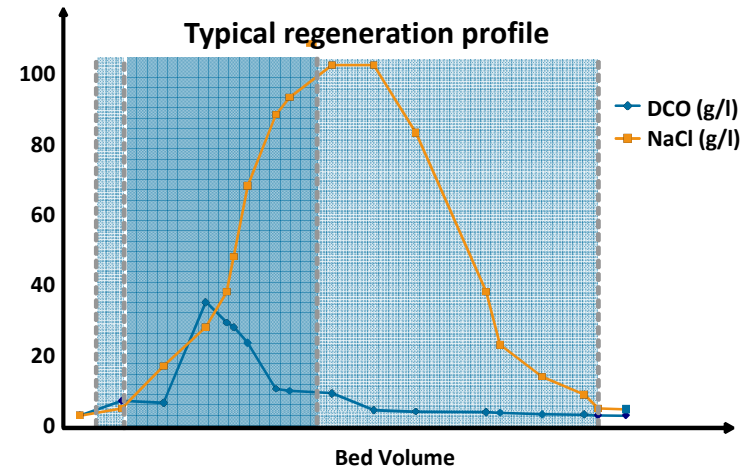
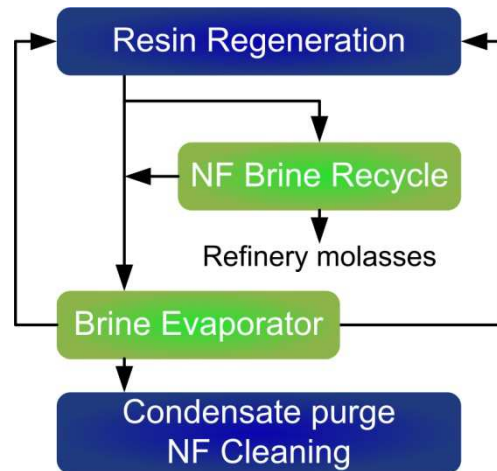
With NF brine recycle, the resin regeneration cost in chemicals is reduced by 1/3

# Atmospheric Pre-Concentration System



The atmospheric pre-concentration system uses low calories hot water: resin regeneration cost in chemicals is reduced by up to 50%

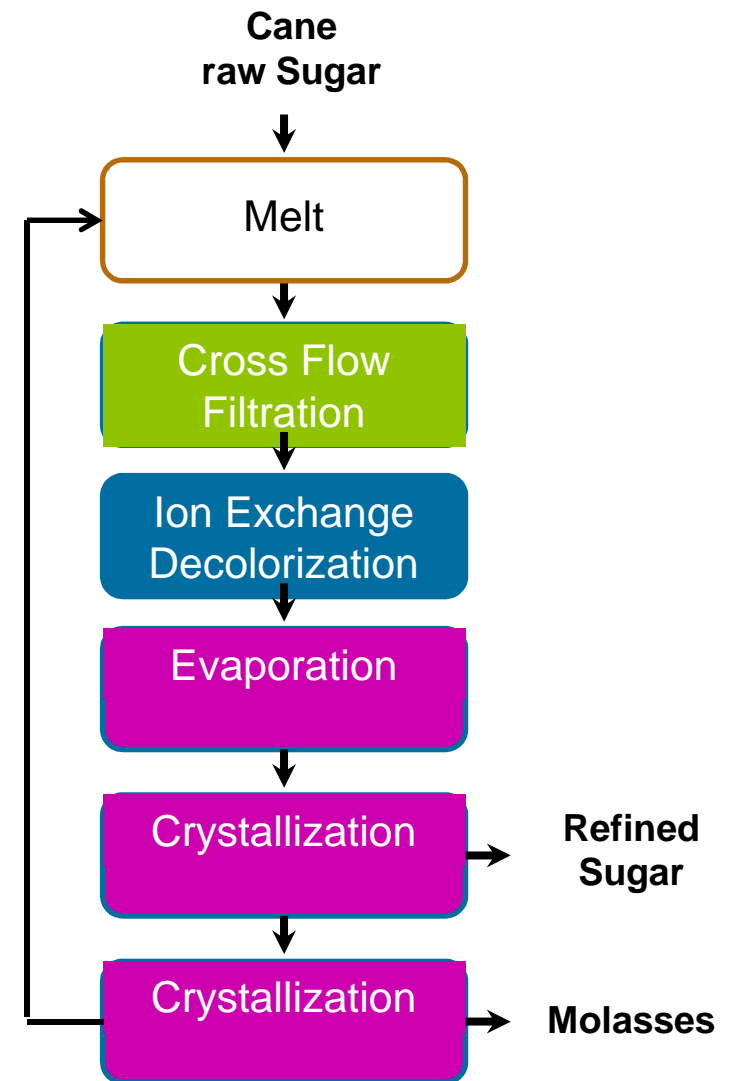
# Brine Evaporator System



With the steam plate & frame evaporators, NaCl consumption is drastically reduced, further optimizing regeneration costs

## Alternative refining process adapted to small capacity

- **Smaller Refineries (50-250 tpd typically) can be designed without affination & liming carbonation**
- **The purification of raw sugar is achieved via**
  - high performance cross flow filtration on ceramic membranes
  - Ion Exchange decolorization



# High Grade Liquid Sugar for Local Markets

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## High Grade Liquid Sugar for Local Markets

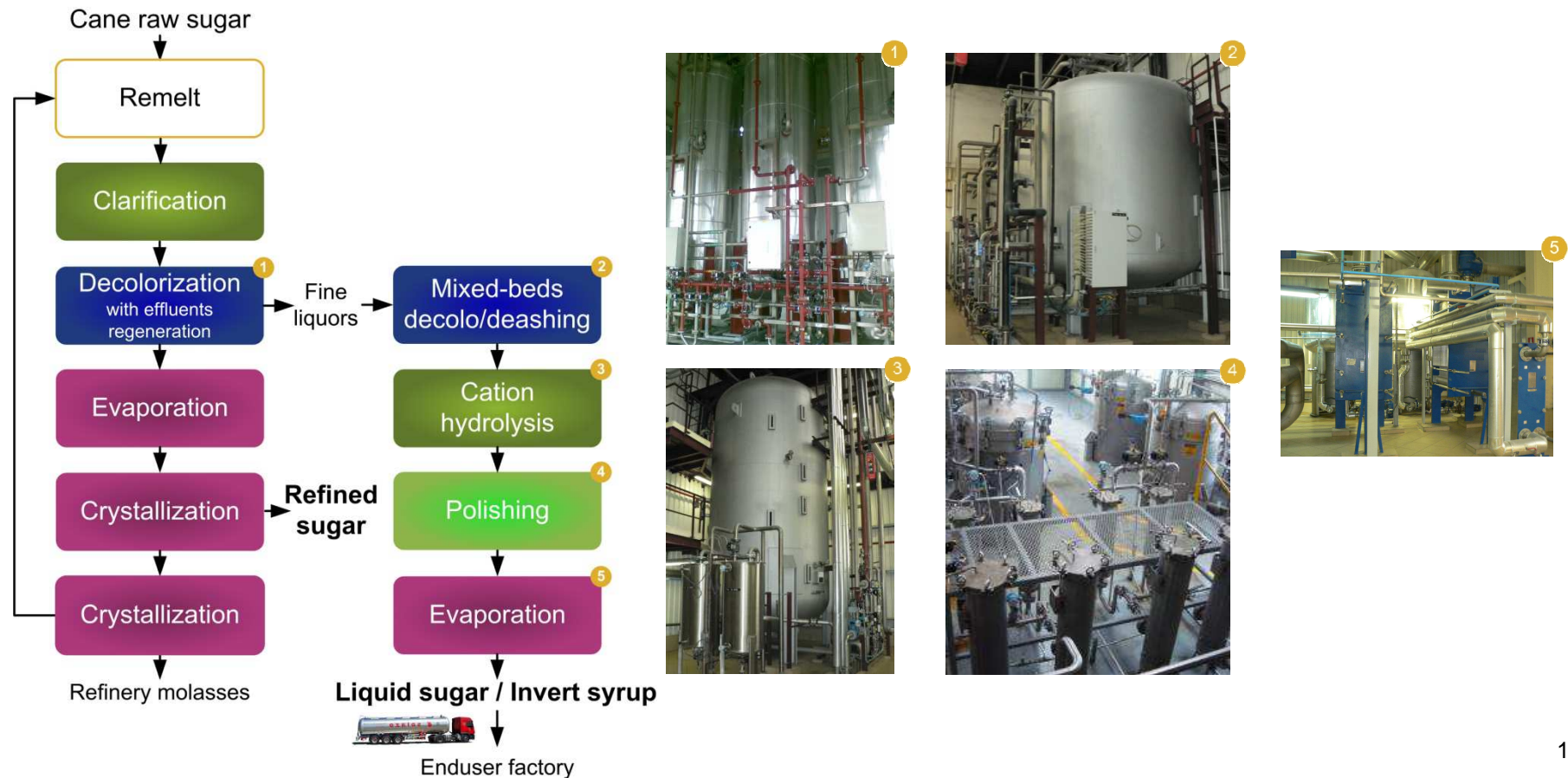
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- **Flexibility** in crystalline refined sugar/liquid sugar production, depending on the season
- **Higher value product** for specific local market
- Potential expansion of the total production capacity of an existing refinery:
  - Without any modification of the sugar house
  - Without generating additional refinery molasses
  - **Parallel processing of fine liquor** for producing refined sugar and liquid sugar
- Large-scale production of liquid sugar offers renewed opportunities for **complete integration of the liquid sugar process within the main refinery process**

# High Grade Liquid Sugar for Local Markets

## Optimized solution!

Direct production of liquid sugar from decolorized fine liquor as raw material at the refinery, concurrently with crystalline refined sugar



## Production of Medium Invert Syrup

### Typical specification for Medium Invert 66 Syrup:

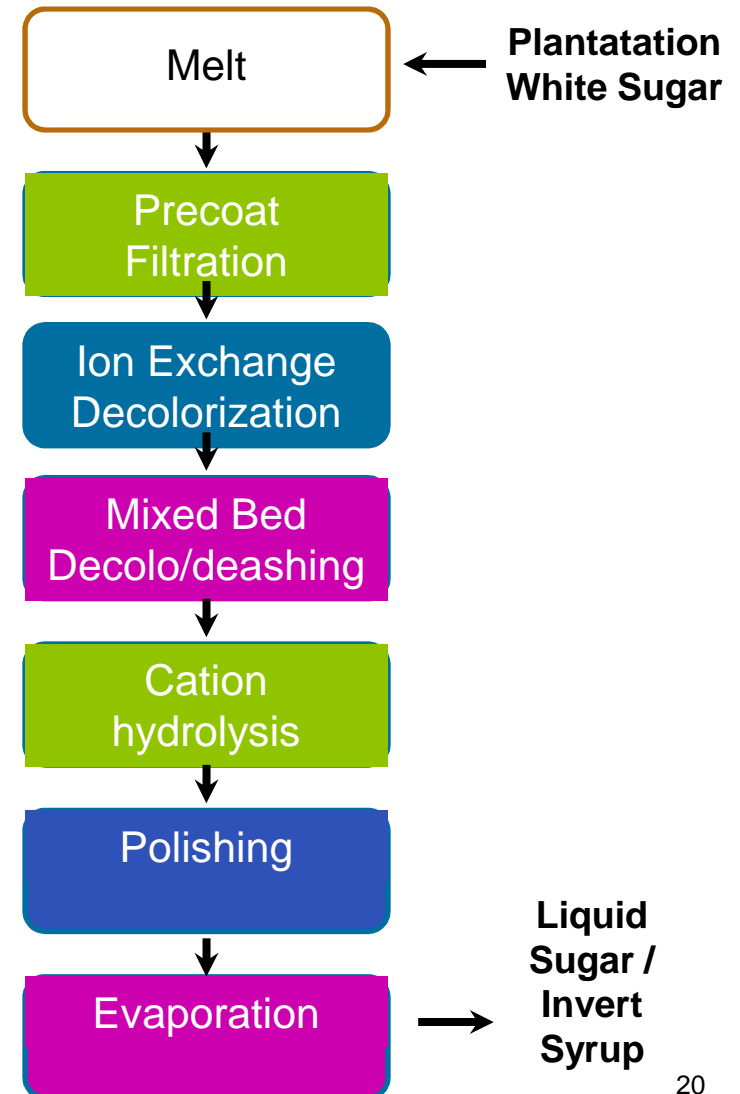
- Concentration: 73% Brix
- Sucrose : 34% on TS
- Glucose + Fructose : 66% on TS
- Color : 25 – 50 Icumsa
- Ash content : 0,05 – 0,10% on TS
- Sugars concentration : 1000 g/l

### **A higher concentration can be used for storage and delivery, which provides significant benefits both for the refinery and end-users:**

- reduced volume for storage and transport (73 Brix instead of 67 Brix)
- better microbial stability (less water activity in the syrup) and longer shelf-life
- easy formulation for European end users : 1 liter = 1 Kg of total sugars
- better stability of the sugars profile : liquid sugar is usually inverted in acid beverages in a few days to the same final sugars profile as Medium Invert. This inversion is causing a volume retraction and potential difficulties for proper filling when using liquid sucrose. When using Medium Invert 66 Syrup, the filling process is much better controlled and stable over time.

# Liquid Sugar Process from plantation white sugar

- **Liquid Sugar can be obtained from plantation white sugar through a simplified process.**
- **The purification into liquid sugar is achieved via**
  - Precoat filtration
  - Ion Exchange decolorization
  - Mixed Bed decolorization and demineralization
  - Optional Cation hydrolysis for the production of invert syrup
  - Polishing by activated carbon
- **This process is also suitable for small stand alone liquid sugar plant, and can be installed at end user plant**



- Production of high quality crystal or liquid sugar meeting the qualitatively and quantatively increasing needs of food industry can be achieved via:
- NAP processes produce higher quality VHP sugar directly at the mill
- Optimized ion-exchange decolorization systems for cane refinery liquors
- Alternative refining process for small refineries
- Integration of a line producing specific liquid sugar from fine liquors in the main refinery process to serve local market
- Alternative liquid sugar process line from plantation white sugar



**Thank you for your attention!**

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