CABOT

NORIT ACTIVATED CARBON

Cabot Norit Activated Carbon for the Purification of starch based sweeteners

Starch Based Sweeteners , April 2017
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Sr. Activated Carbon Specialist

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- 2. How does the AC work in Starch sweeteners?
- 3. How to apply?
- 4. Where and how it is used in practice?
- 5. What product should you select?
- 6. Why should the customer choose Cabot?

Introduction to activated carbon

Cabot AC in the Food and Beverage segment

Example applications for activated carbon:

- Decolorization of sugar syrups, juices, (non) alcoholic beverages, organic acids and their salts.
- Purification, taste and odour correction of food and beverage products
- Decontamination of vegetable and marine oils
- Decaffeination of coffee & tea
- Recycling of waste sugar in sweets production
- Purification of edible lactose
- ….and many more applications

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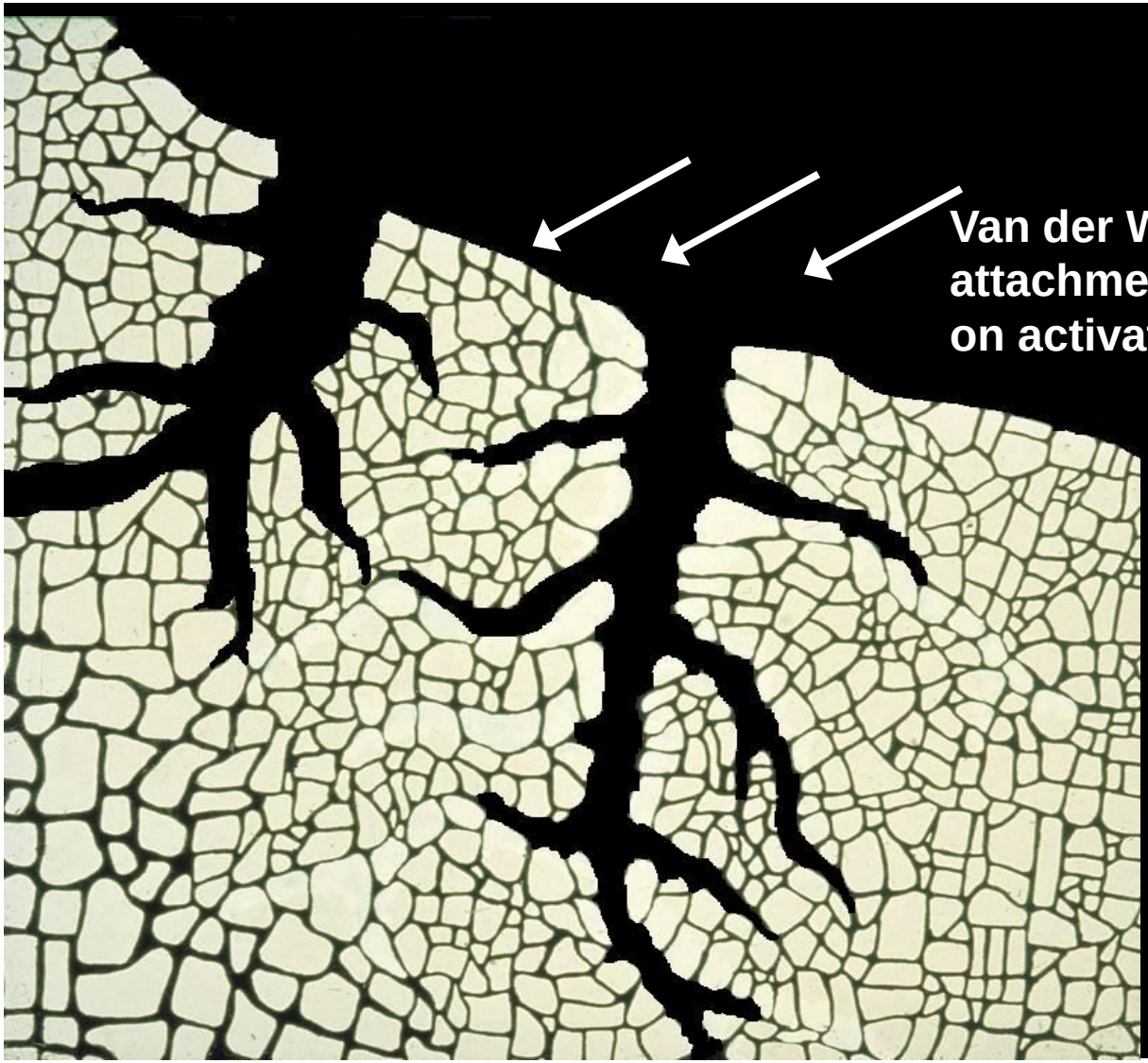
Leads for Cabot AC in starch based sweeteners?

6 Key Questions:

- At which stage in the purification process, product to be treated?
- Which impurity (impurities) to remove at that stage?
- Impurity concentration, color level before and after treatment?
- Size of the flow in m3/hour, dry solid content?
- Operational process conditions (temperature, pH)?
- Already using activated carbon? Which grade?

How Does the Activated Carbon work?

2. How Does the Activated Carbon work?



Van der Waals forces enable attachment carbonaceous material on activated carbon

Micro pores < 2 nm Ø
Meso pores 2-50 nm Ø
Macro pores > 50 nm Ø

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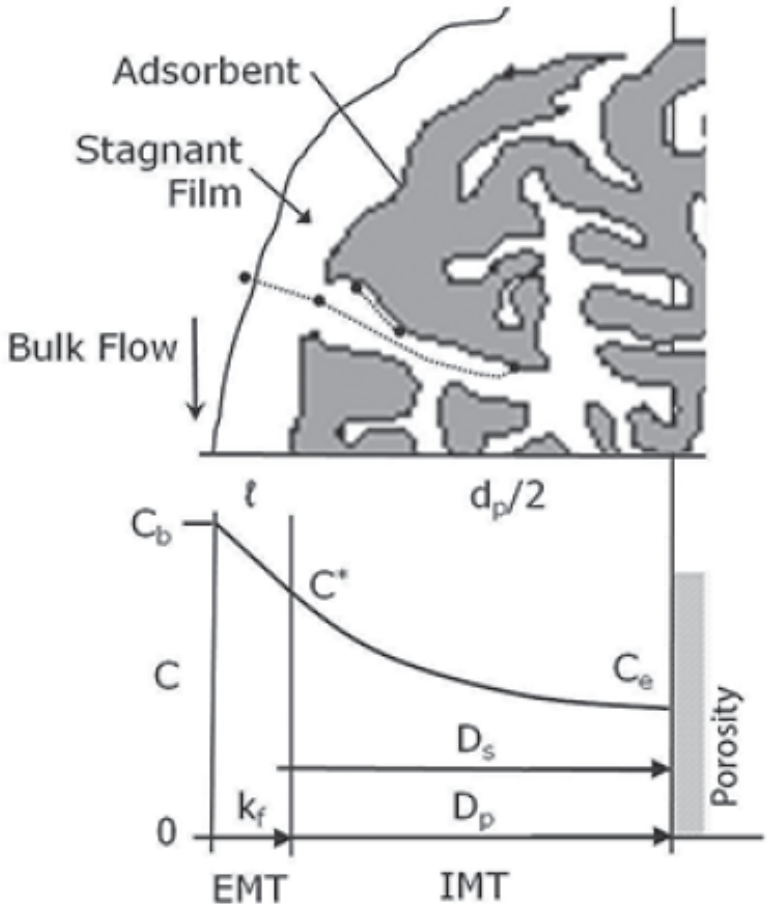
2 How does the Activated Carbon work?

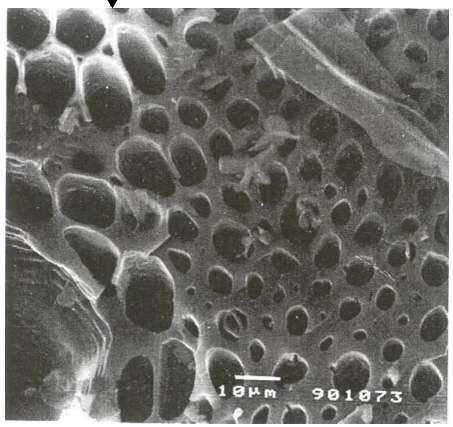
Adsorption process

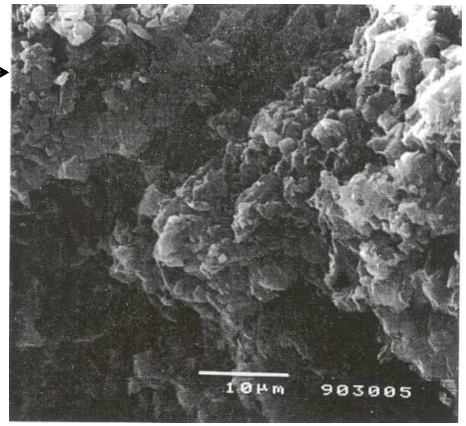
Mass transfer – adsorption kinetics



2 How Does the Activated Carbon work?

- 2 production methods of Activated Carbon
  - Steam Activated Carbons (SAC)
  - Chemically Activated Carbons (CAC)
- Pore structure influenced by
  - Manufacturing method
  - Raw material





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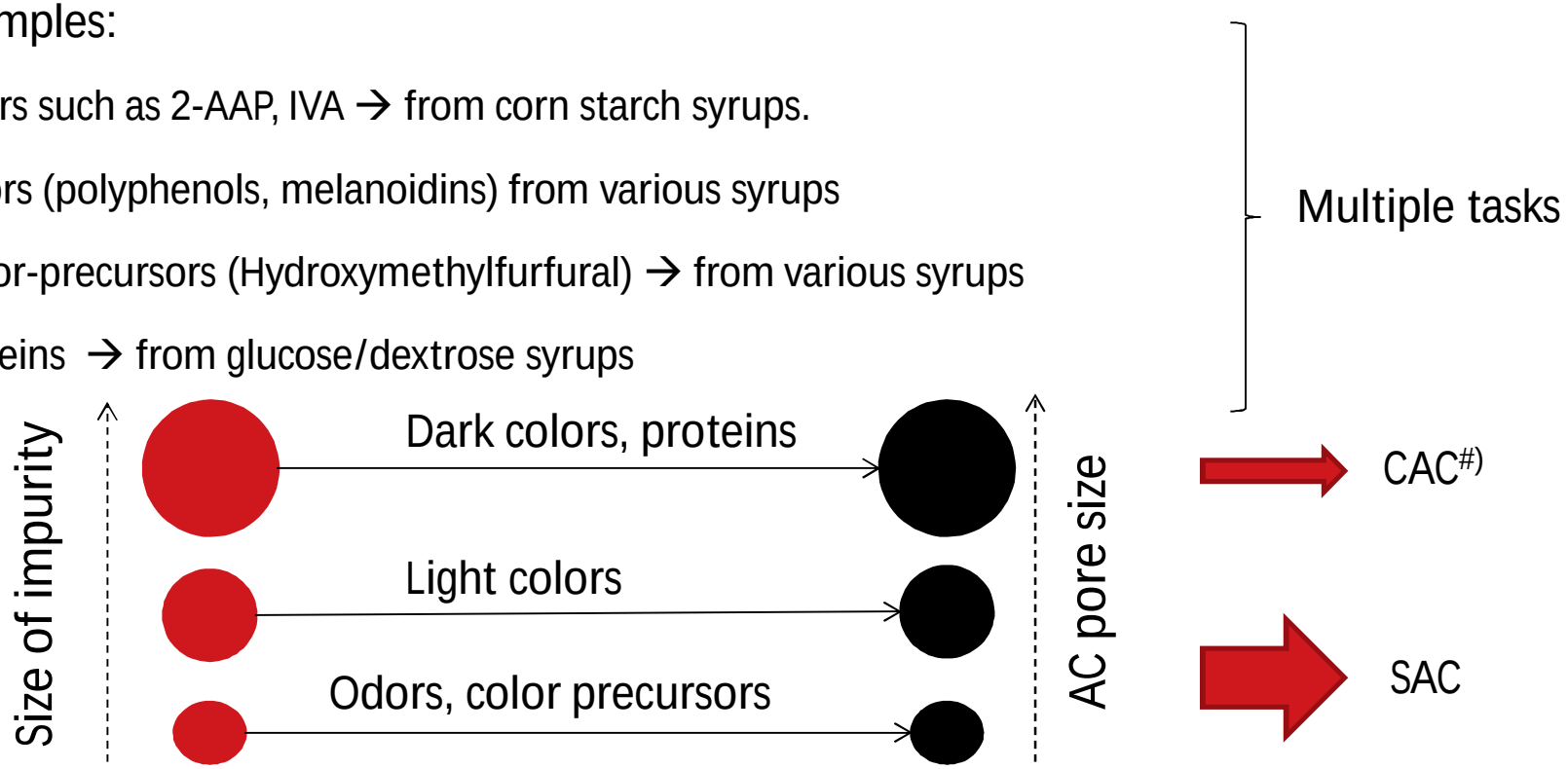
2 How Does the Activated Carbon work?

- What has to be removed within the starch sweetener purification application?

  Examples:

  - Odors such as 2-AAP, IVA → from corn starch syrups.
  - Colors (polyphenols, melanoidins) from various syrups
  - Color-precursors (Hydroxymethylfurfural) → from various syrups
  - Proteins → from glucose/dextrose syrups



#) only in case of PAC, in case of GAC → Steam Activated Carbon (SAC)

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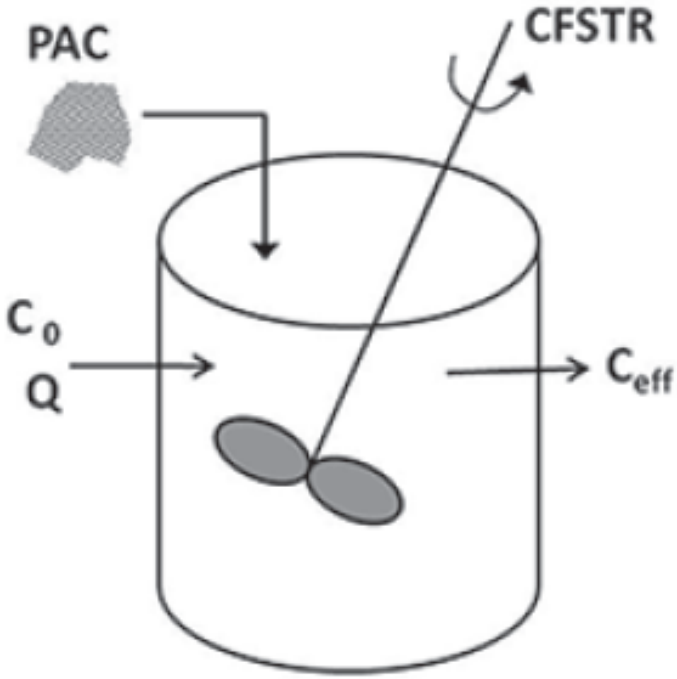
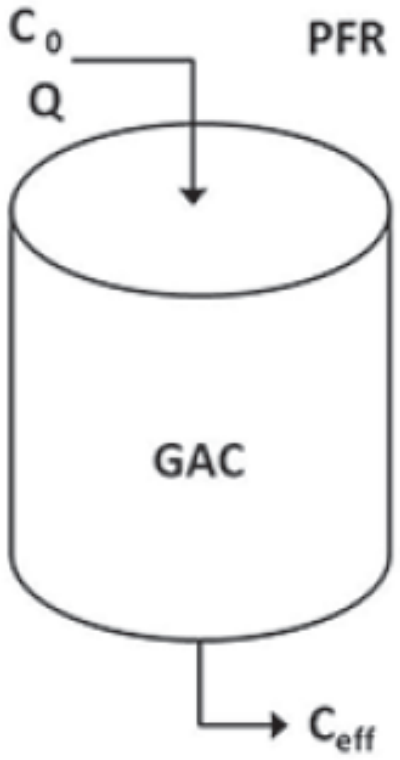
3 How to Apply?

3 How to Apply?

Powder versus Granular Activated Carbon





3 When to apply PAC ?

- Suitable for batch processes
  - + flexible in grade and dosing
  - + easy incorporated
  - + low investment cost in system compared to GAC process
  - - standard PAC: dirty handling unless using dedicated dosing systems
  - - filter cakes with filter aid to dispose (not applicable for GAC)
  - - high operational costs compared to GAC process
- Separation PAC from liquid by filtration
- Filtration behaviour important parameter

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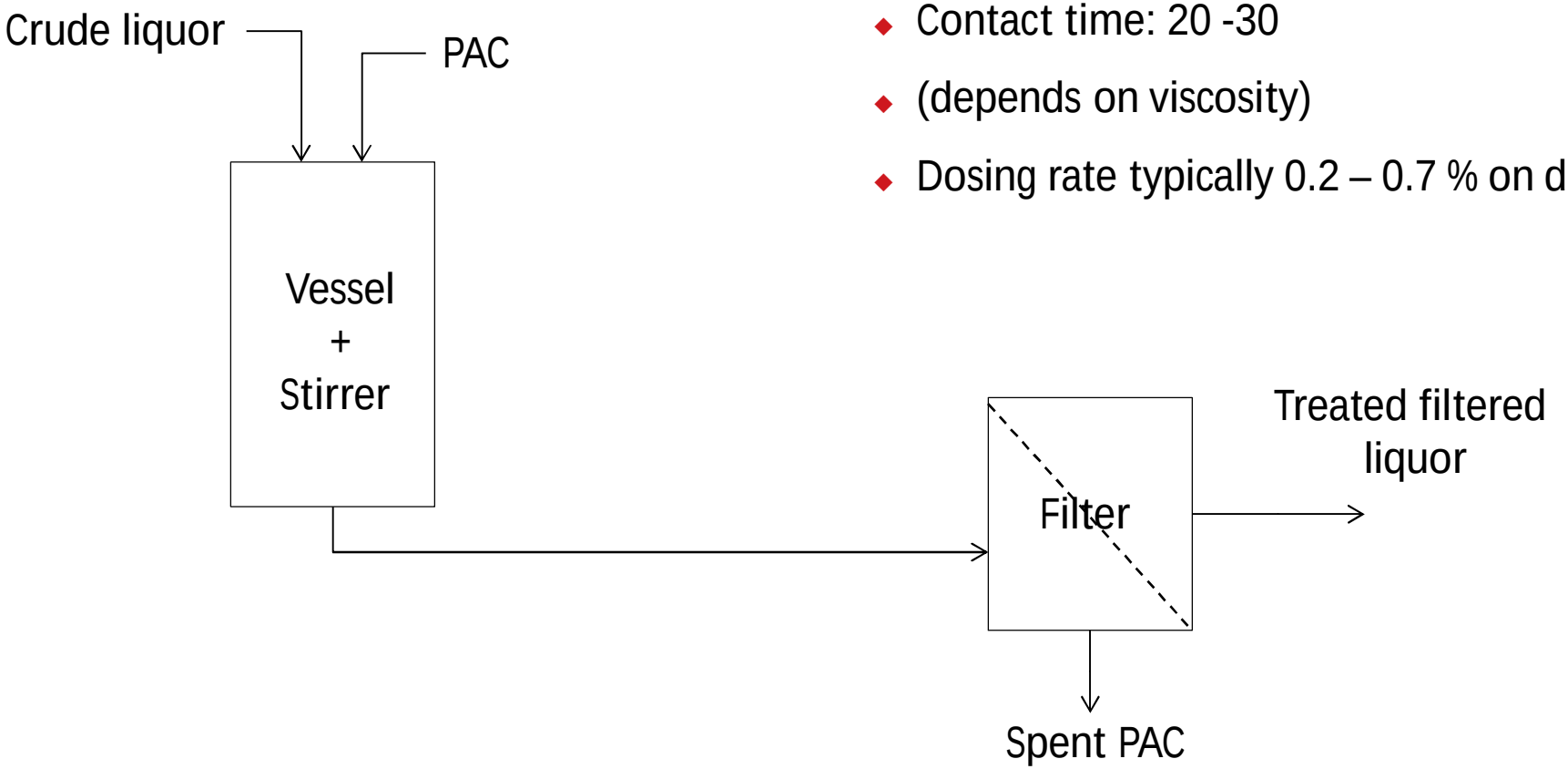
3 PAC process in starch based sweeteners

Typical process conditions:

- Temperature: 65 -75 Degr. C
- Contact time: 20 -30
- (depends on viscosity)
- Dosing rate typically 0.2 – 0.7 % on d.s



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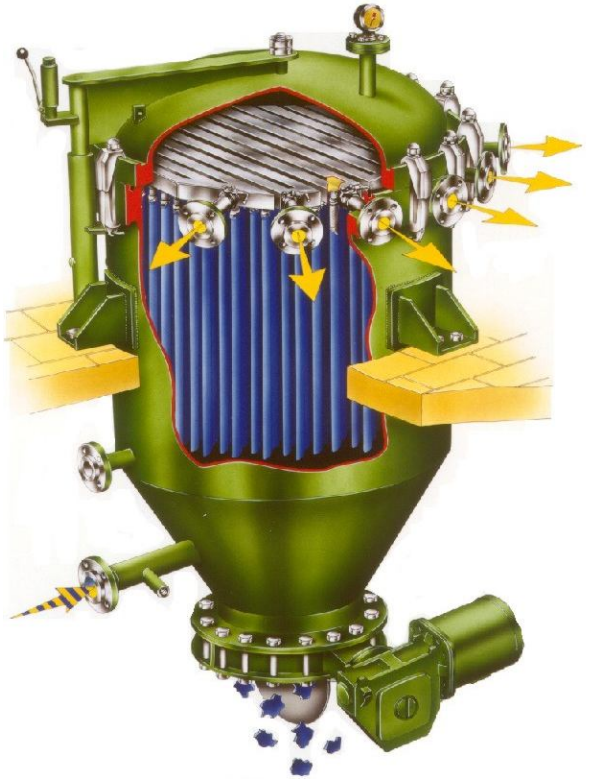
3 PAC Filtration from syrups

Common PAC filter types for filtration of PAC suspensions with filter aid:

- Pressure leaf filters
- Reversed flow tube filters (picture)
- Rotating disc filters



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How to Apply?

Powdered Activated Carbon

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3 When to apply GAC

- Suitable for continuous flow, no stops, large operations
  - + low operational costs compared to PAC proces
  - + clean
  - + regeneration
  - + no additional AC separation step
  - - high investment costs compared to PAC process
  - - less flexible regarding process changes compared to PAC process

- Mechanical properties (high abrasion resistance, regeneration)

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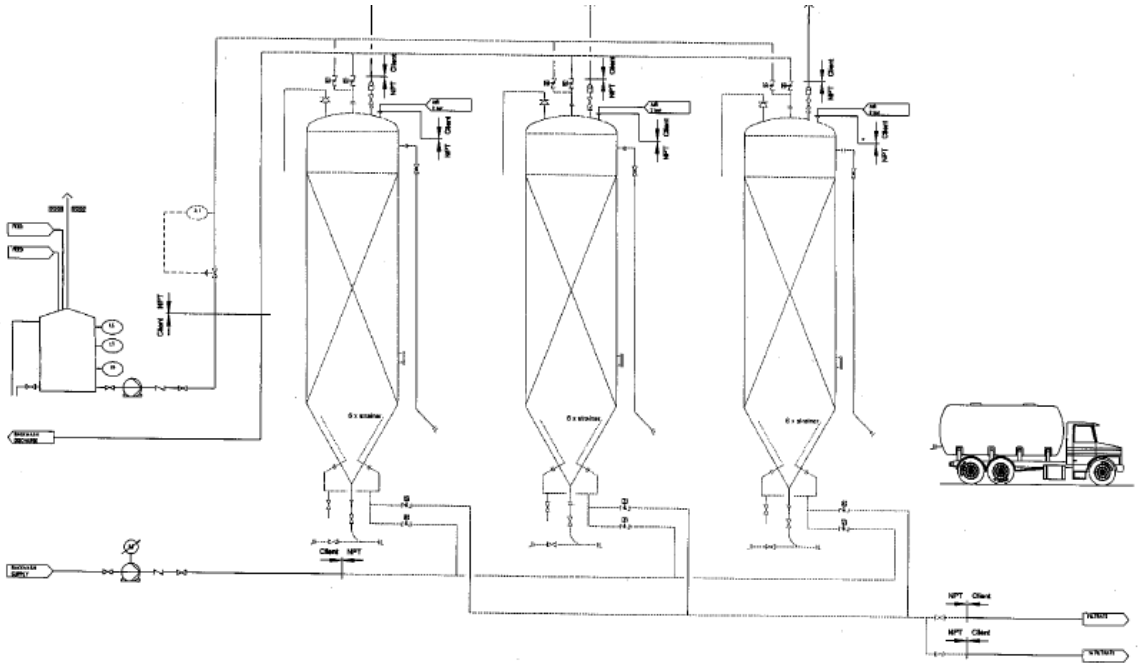
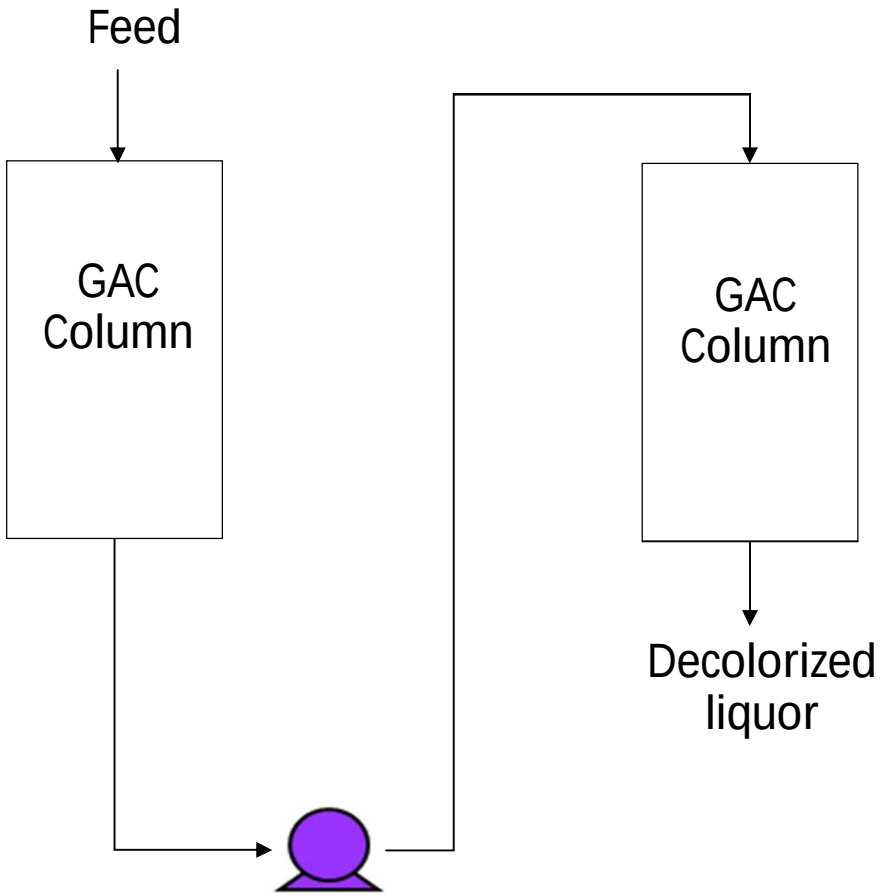
3 Fixed bed GAC system

Features fixed GAC bed adsorbers:

- High flexibility
- Optional: backwashing for classification GAC bed
- Optimum adsorber configuration
- Efficient use of adsorptive capacity
- Clean and simple



3 GAC: fixed bed



Typical process conditions in starch sweeteners:

- Temperature: 65 – 75 °C
- EBCT: 2 – 4 h over columns in serial operation or
- HSV: 0.25 – 0.5 Bedvolumes/h
- Service life: 100 - 400 Bedvolumes

- EBCT: Empty Bed Contact Time [h]
- HSV: Hourly Space Velocity [bedvolumes/h]

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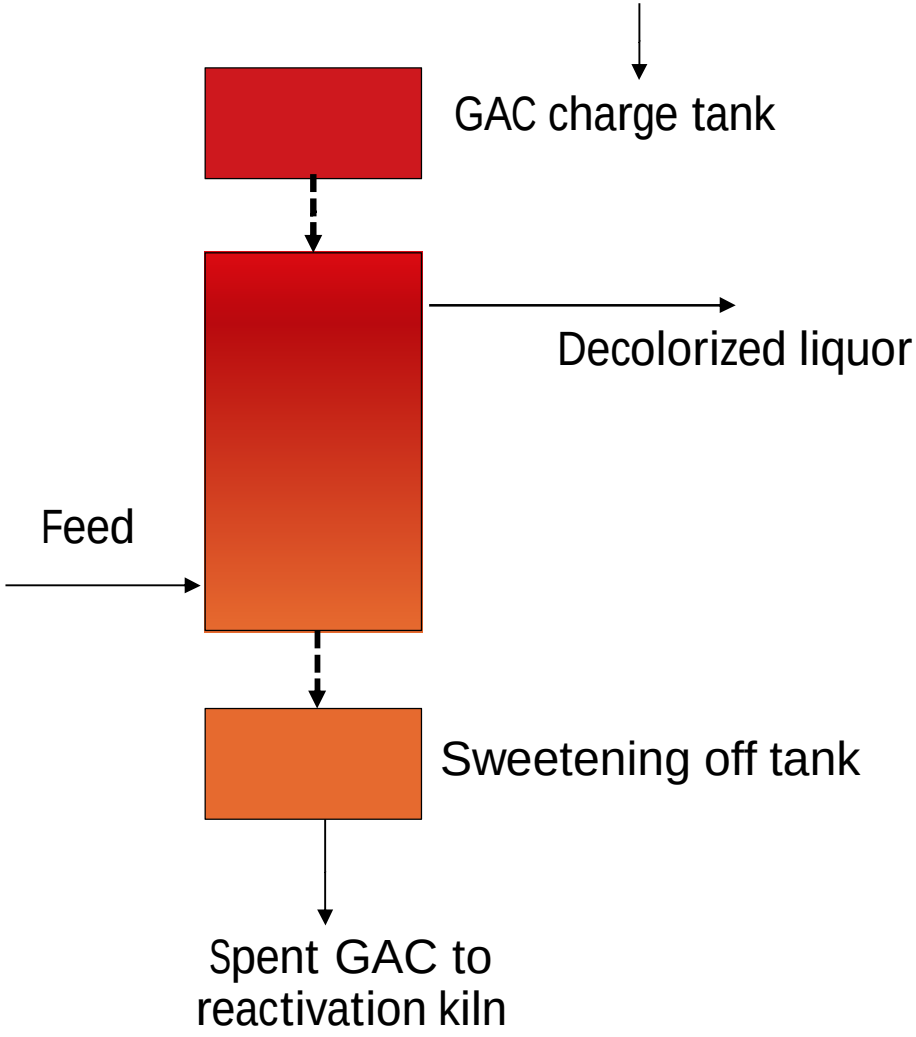
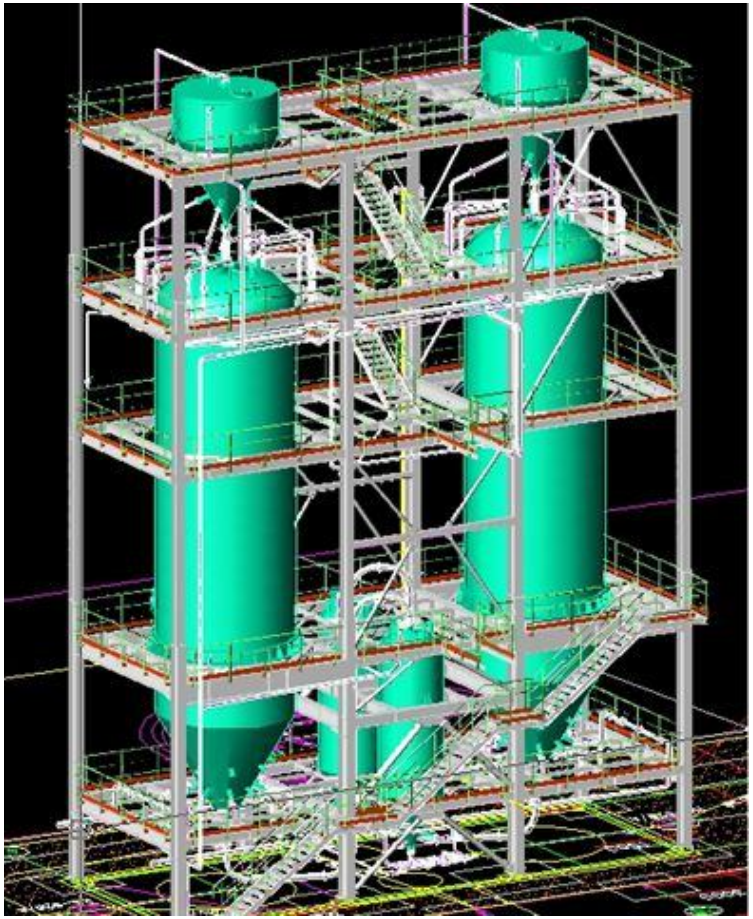
3 Pulsed bed GAC columns

Reactivated GAC from reactivation kiln





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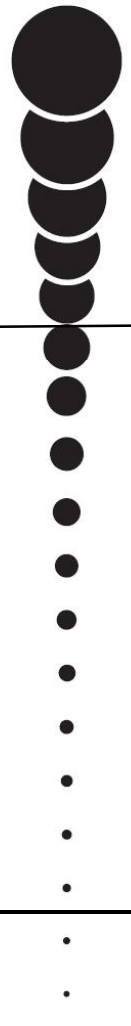
Mesh Sizes

Mesh Size Convertor

SIEVE Opening mm	Particles	ASTM	Former JIS 日本	BS
5.60		3.5	3.5	3
4.75		4	-	3.5
4.00		5	5	4
3.35		6	6	5
2.80		7	7	6
2.36		8	8	7
2.00		10	9	8
1.70		12	10	10
1.40		14	12	12
1.18		16	14	14
1.00		18	16	16
0.85		20	20	18
0.71		25	24	22
0.60		30	28	25
0.50		35	32	30
0.425		40	35	36
0.355		45	42	44
0.300		50	48	52

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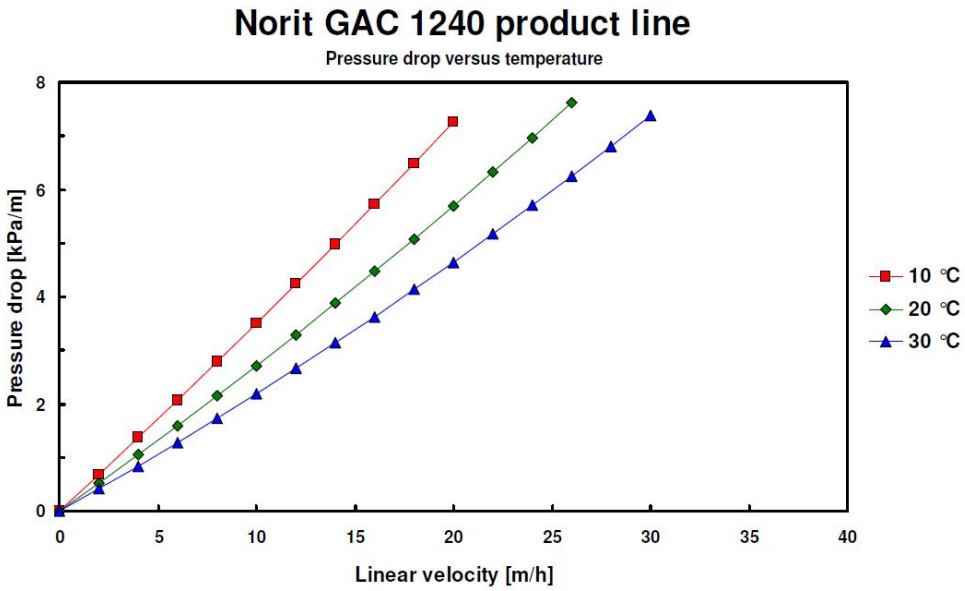
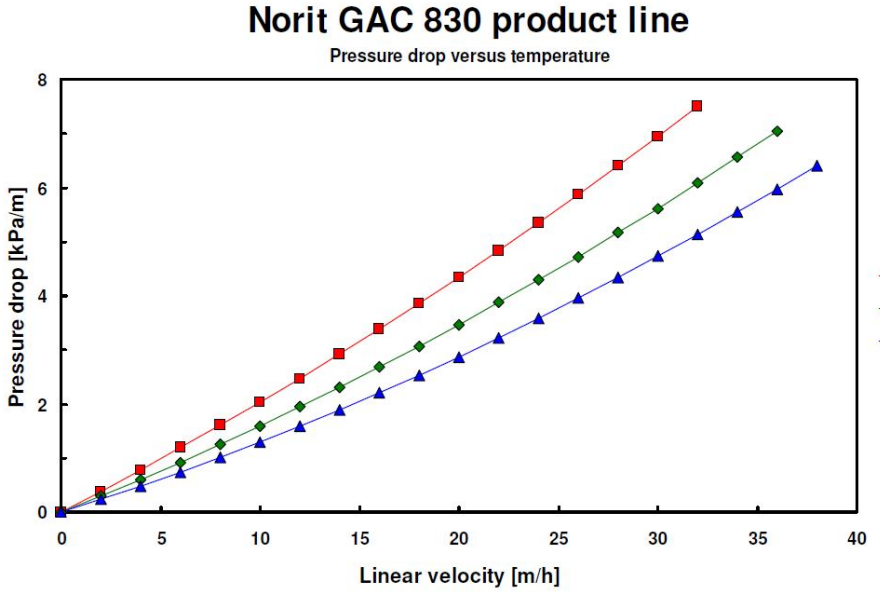
Hydrodynamic properties of GAC

- Particle size distribution having a dominant effect on clean bed pressure drop





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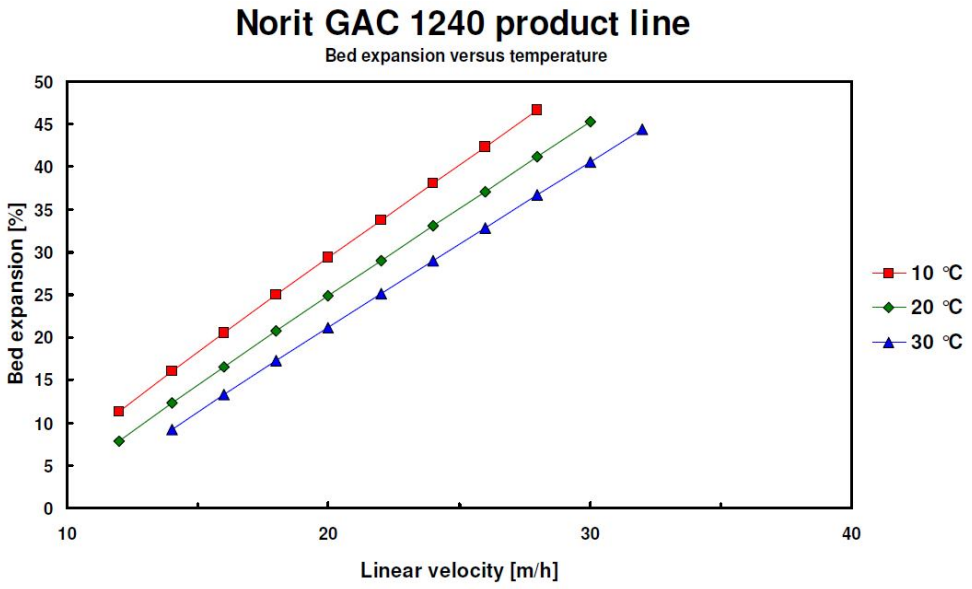
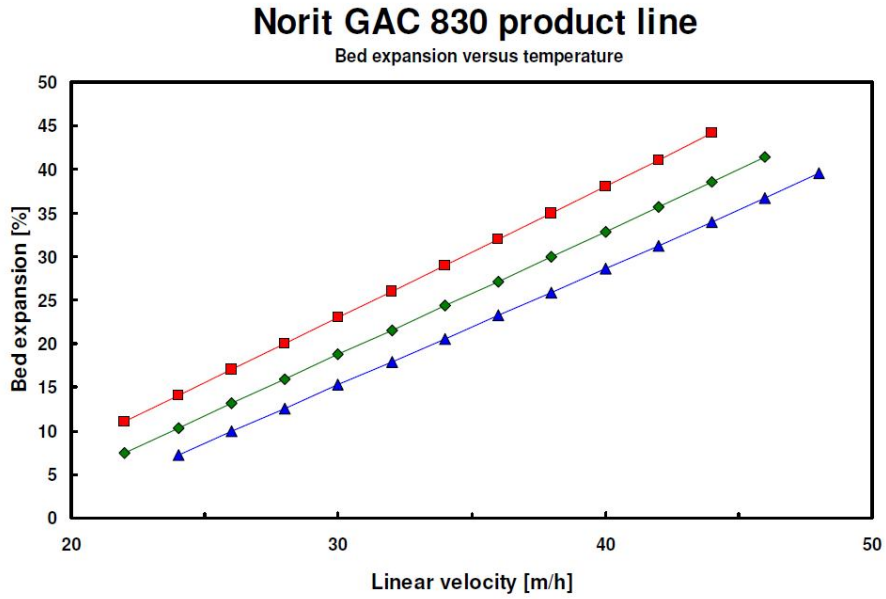
Hydrodynamic properties of GAC

- Particle size distribution having a dominant effect on bed expansion characteristic





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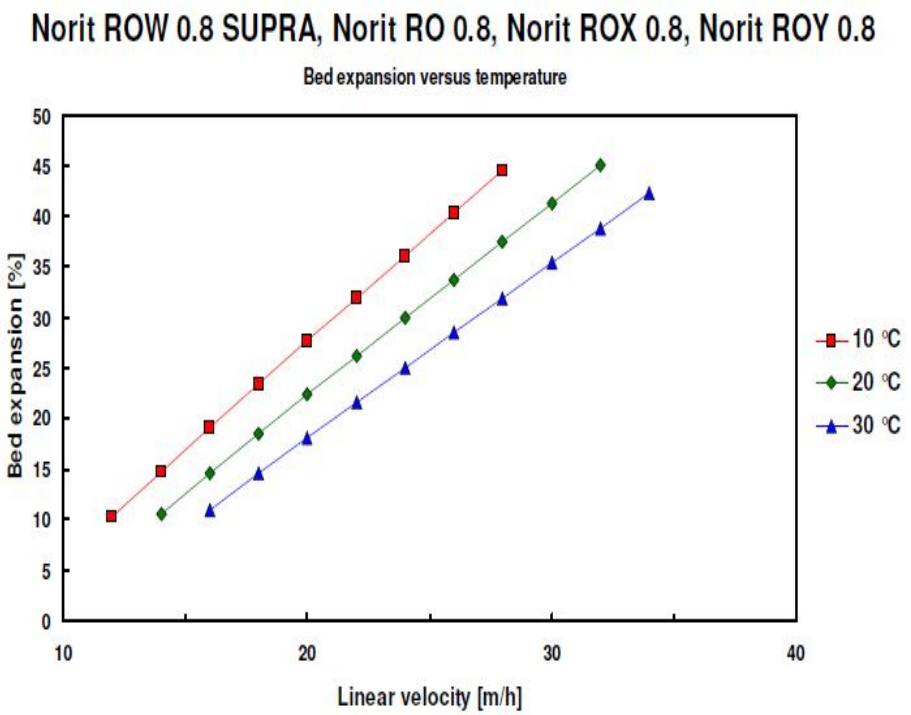
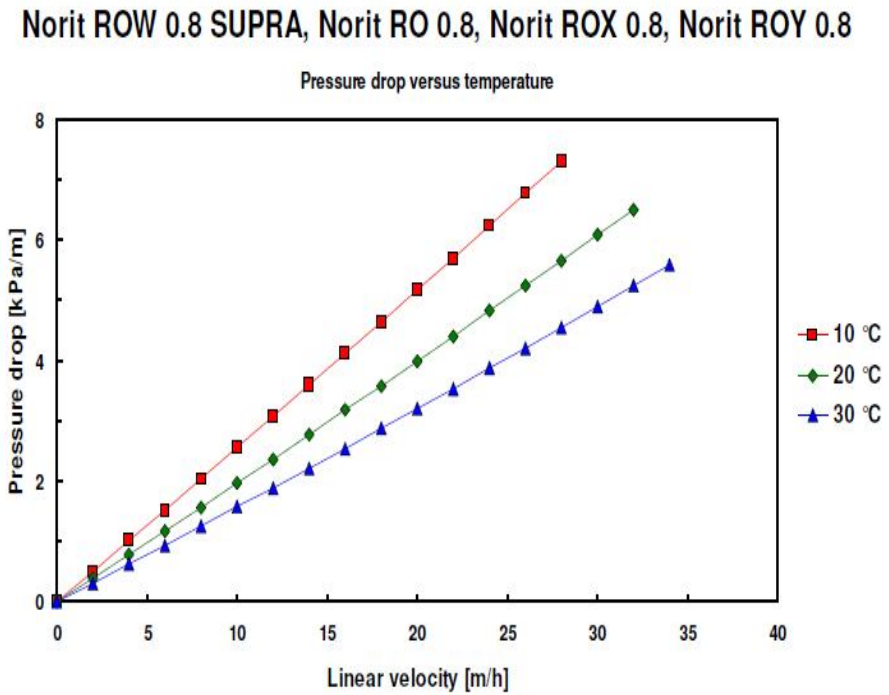
Hydrodynamic properties of GAC

NORIT ROX 0.8 – the ultimate polishing carbon





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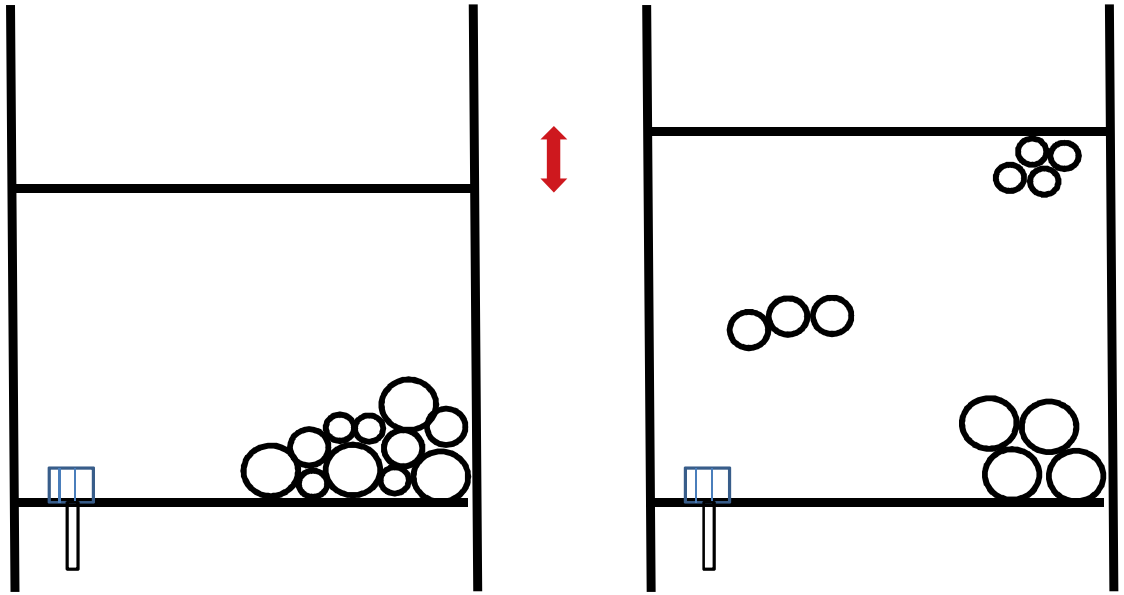
Volume or tonnage of carbon required

- Density Backwashed and Drained = Apparent Density / conversion factor



Apparent Density	Density Backwashed & Drained
Ideal Packed Bed	Classified Packed Bed
Lowest Volume	Higher Volume

Remark: The red arrow shows the difference in volume

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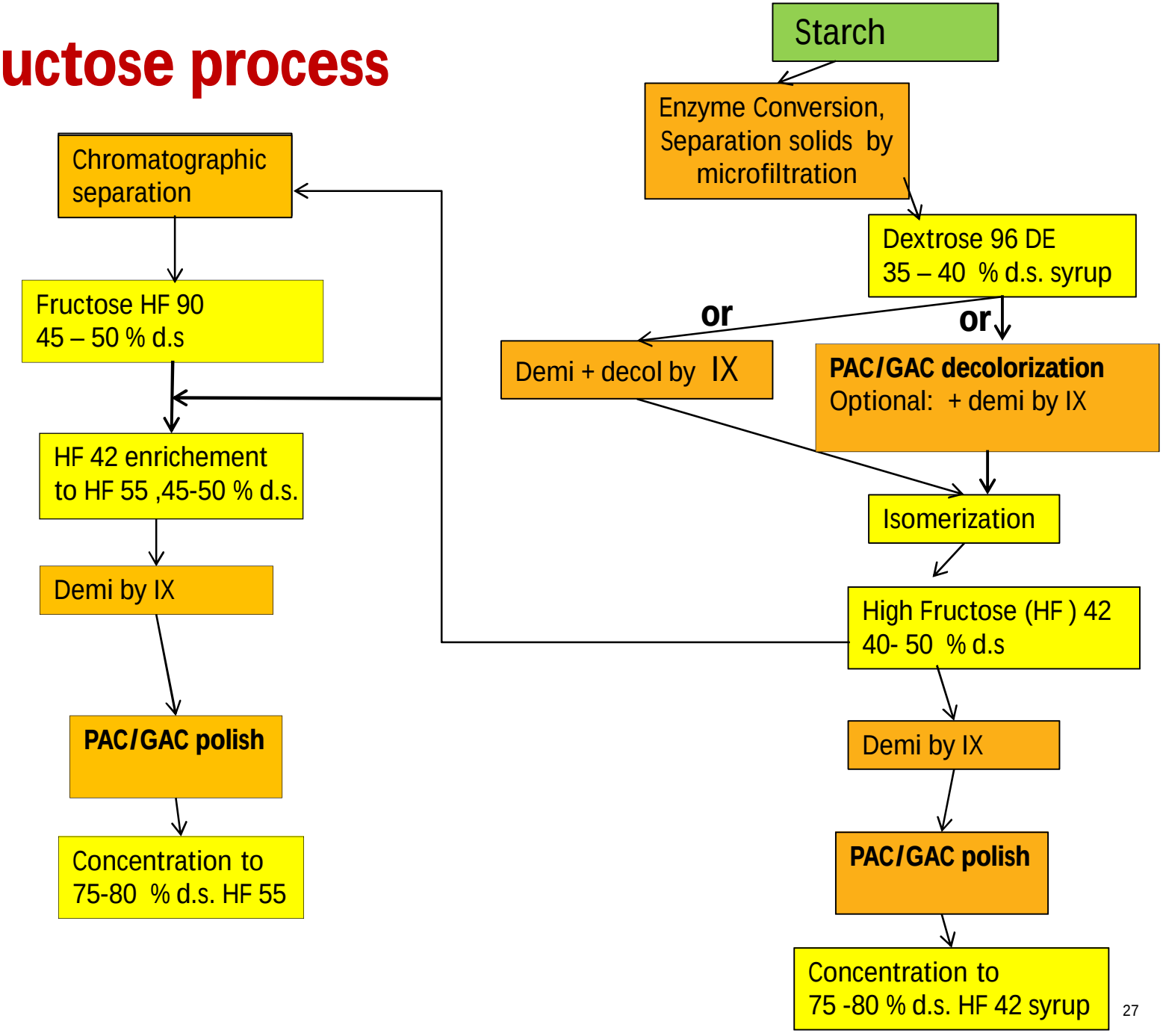
Where is Activated Carbon used ?

High Fructose process



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What Product should You select?

STARCH BASED SWEETENERS: HFS, GLUCOSE, MALTOSE, SORBITOL:

Powdered: Large color bodies & proteins

NORIT® CGSP
Best on large color bodies and proteins

NORIT® CG 1
Good on large color bodies and proteins

NORIT® GBSP
Good on large color bodies, proteins, color precursors

Granular

NORIT® GAC 1240 PLUS
Best comprehensive for adsorption, good on low metal leach, thermally regenerable

NORIT® ROX 0.8
Best polishing carbon , dedicated for use After demineralization ; excellent regenerability.

Powdered: Small color bodies, color precursors, taste & odor

NORIT® SX 1G
Best on small color bodies, color precursors, and off-taste and odor, dedicated for use after demineralization

NORIT® DX1
Good on small color bodies and color precursors, dedicated for use after demineralization

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8 Why Cabot?

- Wide range of food grade carbons for starch sweetener purification
- High standard Quality management systems on food grade carbons
  - Production in NL and UK under scope of HACCP quality management system
  - Reactivation of food carbons in NL and IT under the scope of a HACCP quality management system
  - 100 % traceability of manufactured (and reactivated) lots – quality audits to show compliance with quality standards in the food industry
- Technical literature to support Sales/customers to get the best out of the Cabot AC products in sweeteners purification
- Application Specialists for training/education customers/ OEM's /EPC contractors on the use in or design of AC purification processes.
- Lab test facilities / rental equipment available to support AC testing

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Thank you.