MEMBRANE & ION EXCHANGE TECHNOLOGIES FOR PURIFICATION of COPRODUCT IN AGRO INDUSTRIES

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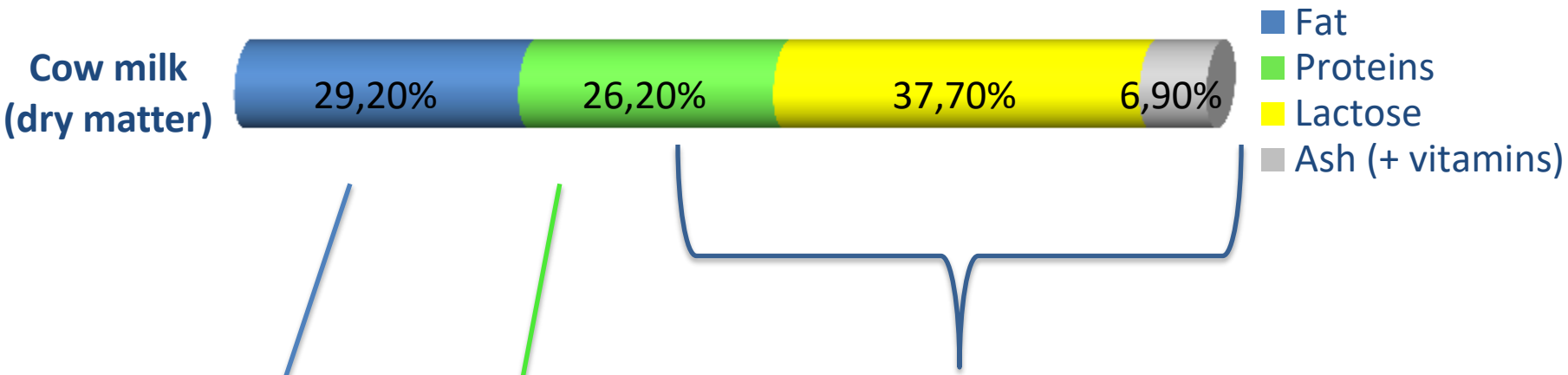
Summary

- *Introduction*
- *Dairy Industries : whey demineralization plant*
- *Sugar Industries : decolorization line in sugar refineries*
- *Wine Industries : wine tartaric stabilization*
- *Agro-Industries : Production of 2G Sugars – Coffee pulp valorization*
- *Conclusions - Perspectives*

DAIRY INDUSTRIES
Whey demineralization plant

WHEY = A VALUABLE RAW MATERIAL



Fat for Cheese / butter / cream…

Casein for Cheese / Casein production…

Whey, co-product of milk transformation :

- **Whey proteins**
- **Lactose**
- **Minerals (+ vitamins)**

FOR WHICH INGREDIENTS WHEY IS USED ?

YOGHURT
WPC

BACKERY
DM50 up to
DM90

ICE CREAM
WPC

CANDIES
DM50 up to
DM90

WHEY

BEVERAGE
Lactose.DM70

INFANT
FORMULA

DM70
DM90

SWEETENER

ANIMAL FEED
DM40

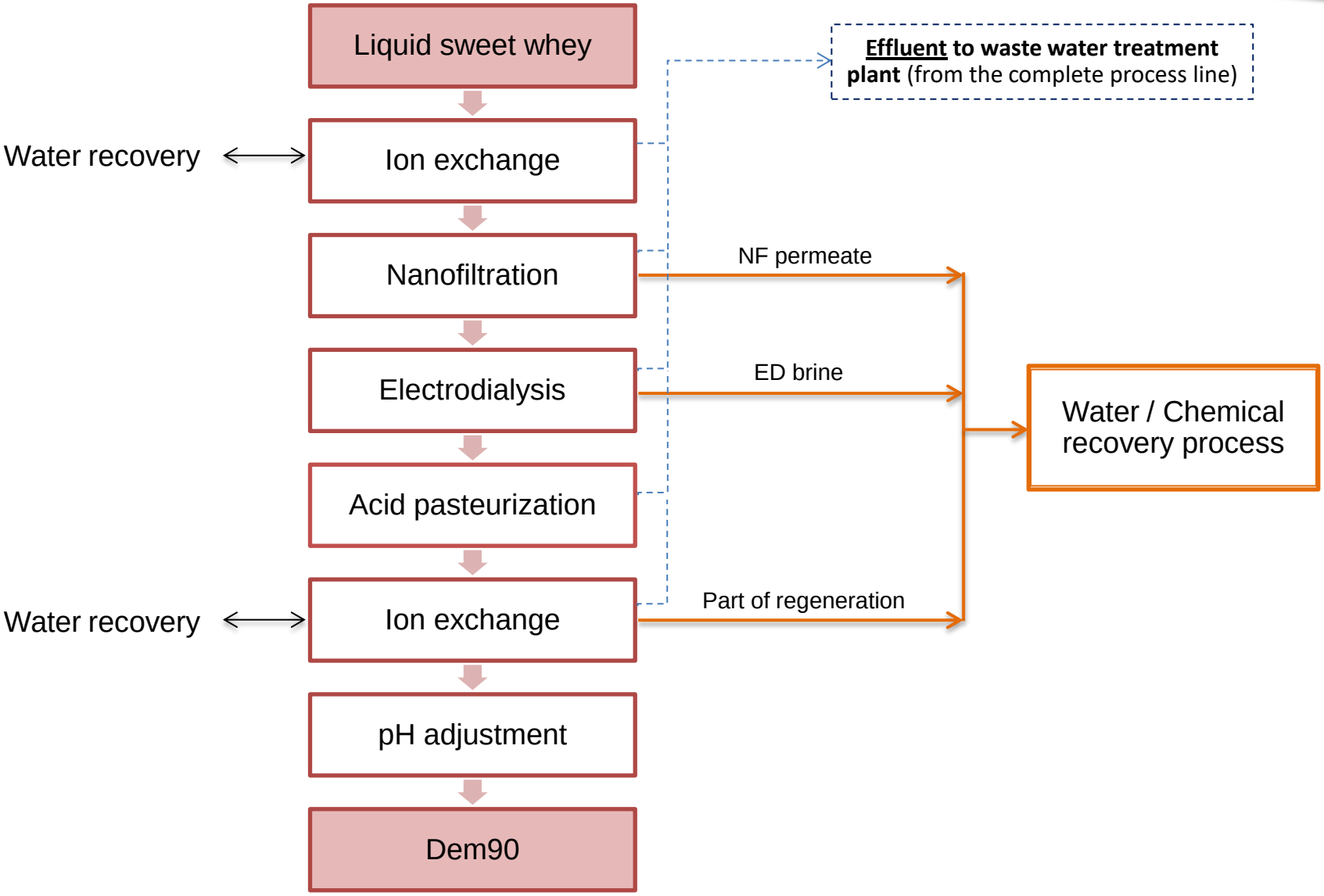
Ion exchange

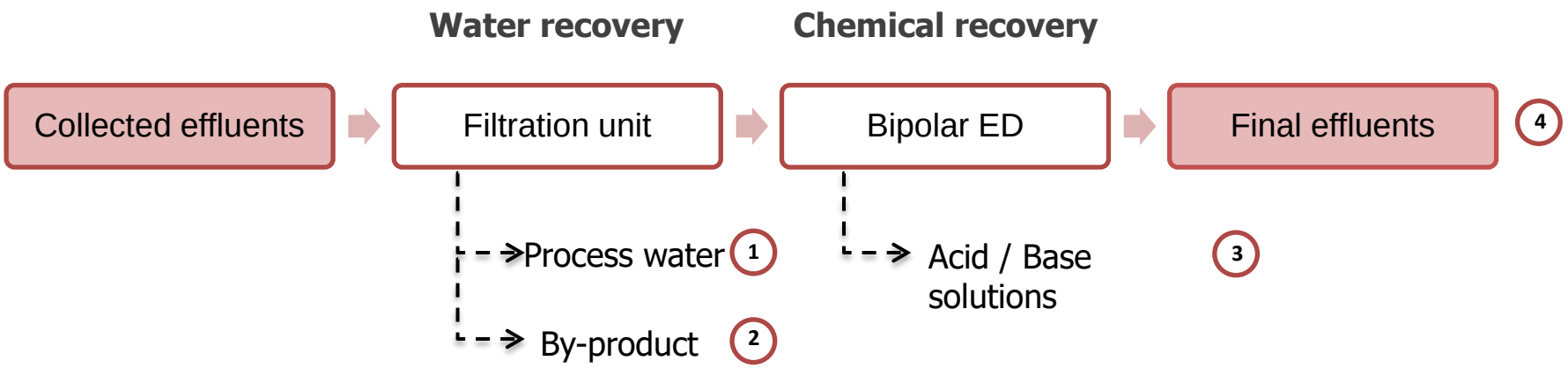
Electrodialysis

Filtration Systems (NF, RO)

- EURODIA is combining part or all technologies to demineralize, function of physico-chemical composition

Dairy Industry – Whey Demineralization





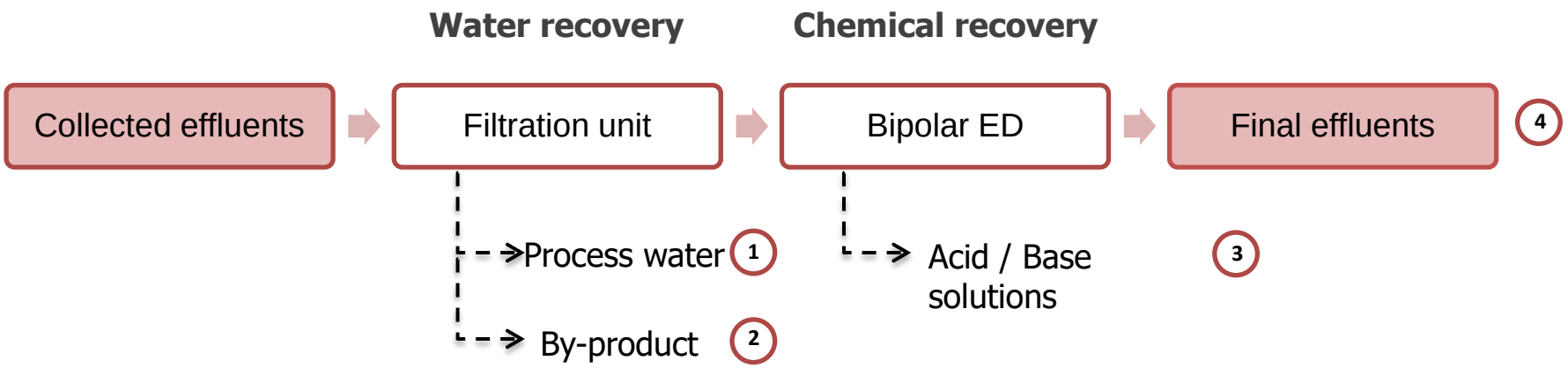
1 Process water : used for IEX regeneration cycle / ED brine / membrane unit CIP (ED & filtration systems)

For example on a complete D90 line :

- Raw whey = liquid whey (6% DS) : complete autonomy in water (and even overproduction)

- Raw whey = RO/NF whey (18-20% DS) : recovery of ~ 50% water consumption

2 By-product which can be valorized as animal feed (~ 25% lactose + NPN / ~ 75% ash + organic acids)



3 Acid / Base solutions : used for IEX regeneration cycle

For example on a complete D90 line :

- Raw whey = liquid whey (6% DS) : saving of ~35% HCl consumption / ~60% of NaOH consumption

4 Reduction of ~ 40% of the effluent BOD released in the waste water treatment plant

Dairy Industry – Whey Demineralization

Water / chemical recovery solution allows :

- Much lower water consumption
- Recovery of valuable by-products
- Reduction of effluent load
- Reduction of chemical consumption

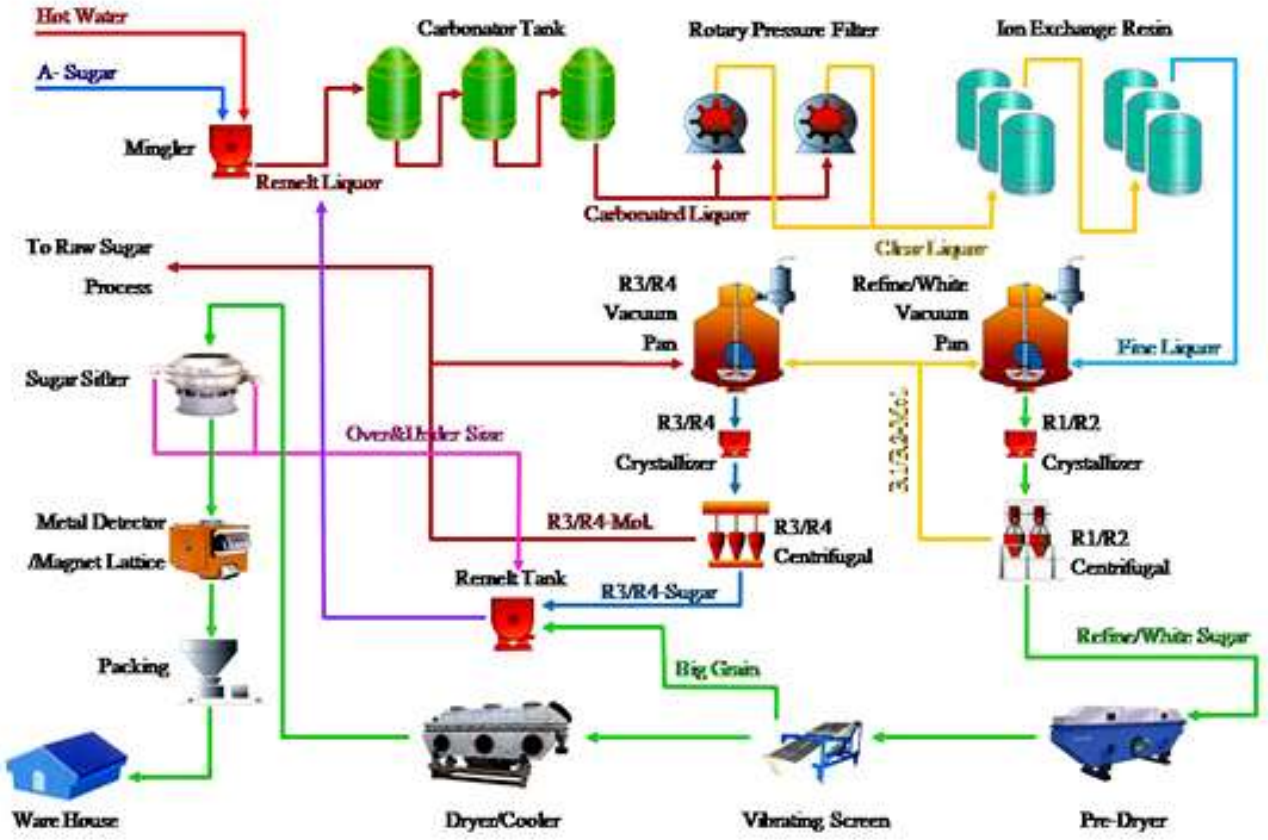
=> With no significant increase of the whole operating cost

⇒ **Perspective** :

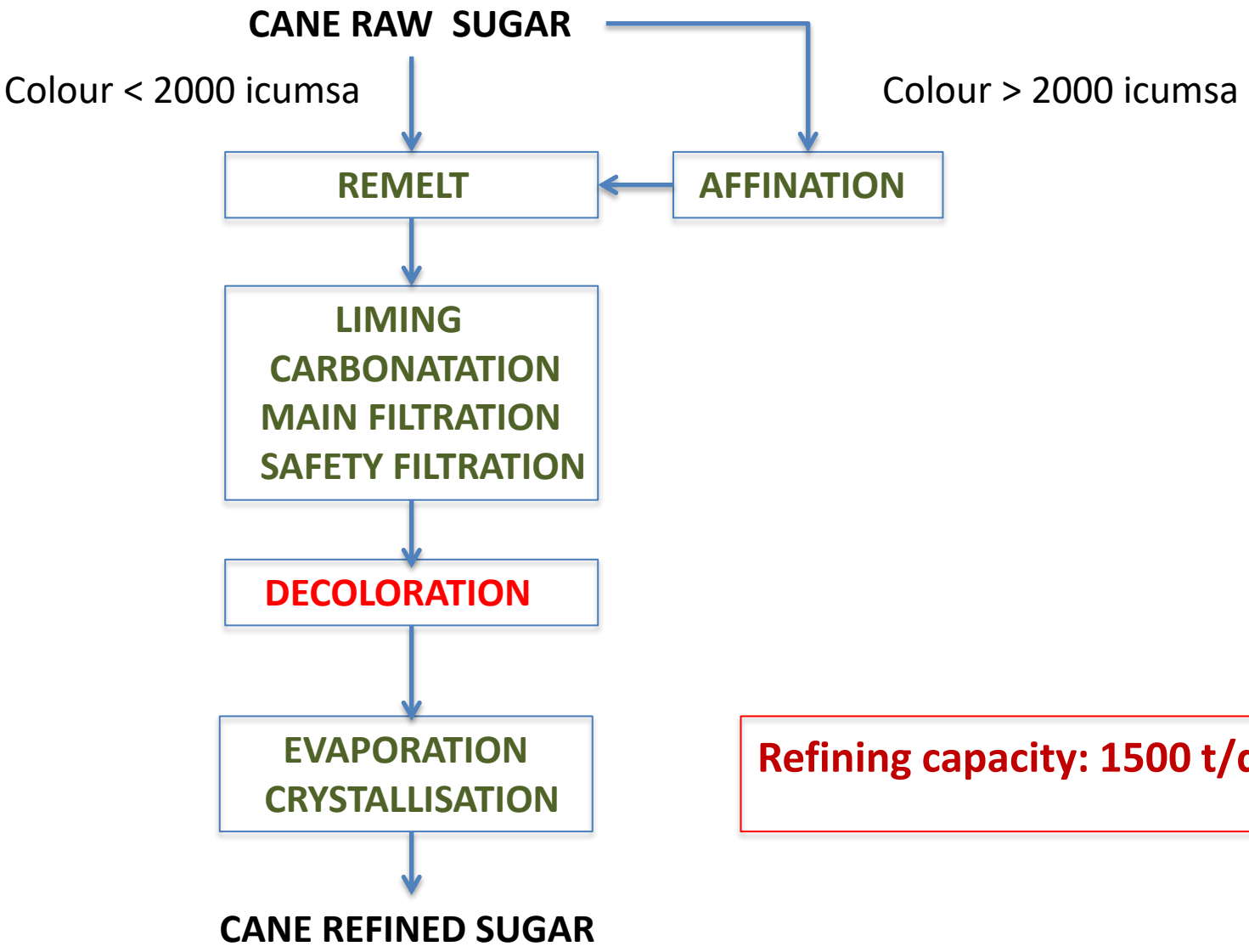
- ❖ 100 % water recovery
- ❖ 100 % chemical recovery
- ❖ Discharge = “natural” minerals + organics coming from whey becoming a valuable product

SUGAR INDUSTRIES
Decolorization Line in Sugar refinery

White Sugar / Refined Sugar Production Processing



kohkongsugar.com



Refining capacity: 1500 t/day

The use of resins as decolorization method step found a new development when nanofiltration membranes have demonstrated their industrial efficiency by decreasing salt consumption and, as a consequence, helping the treatment of the effluents. **Nanofiltration is now considered as a standard for decoloration units.**

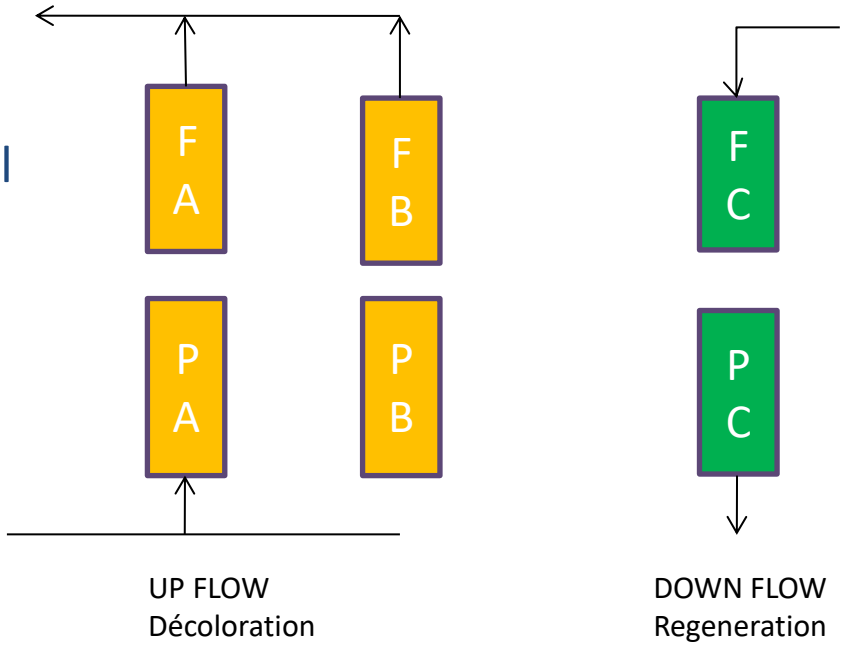
Based on that Knowledge, Eurodia is able to adapt its decolorization process to customer expectation :

- Limit the chloride content in the effluent sent to ponds (Italy)
- Limit water consumption and reduce waste water disposal as much as possible (Middle East)

DECOLORATION RESINS REGENERATION

REGENERATION CONDITIONS

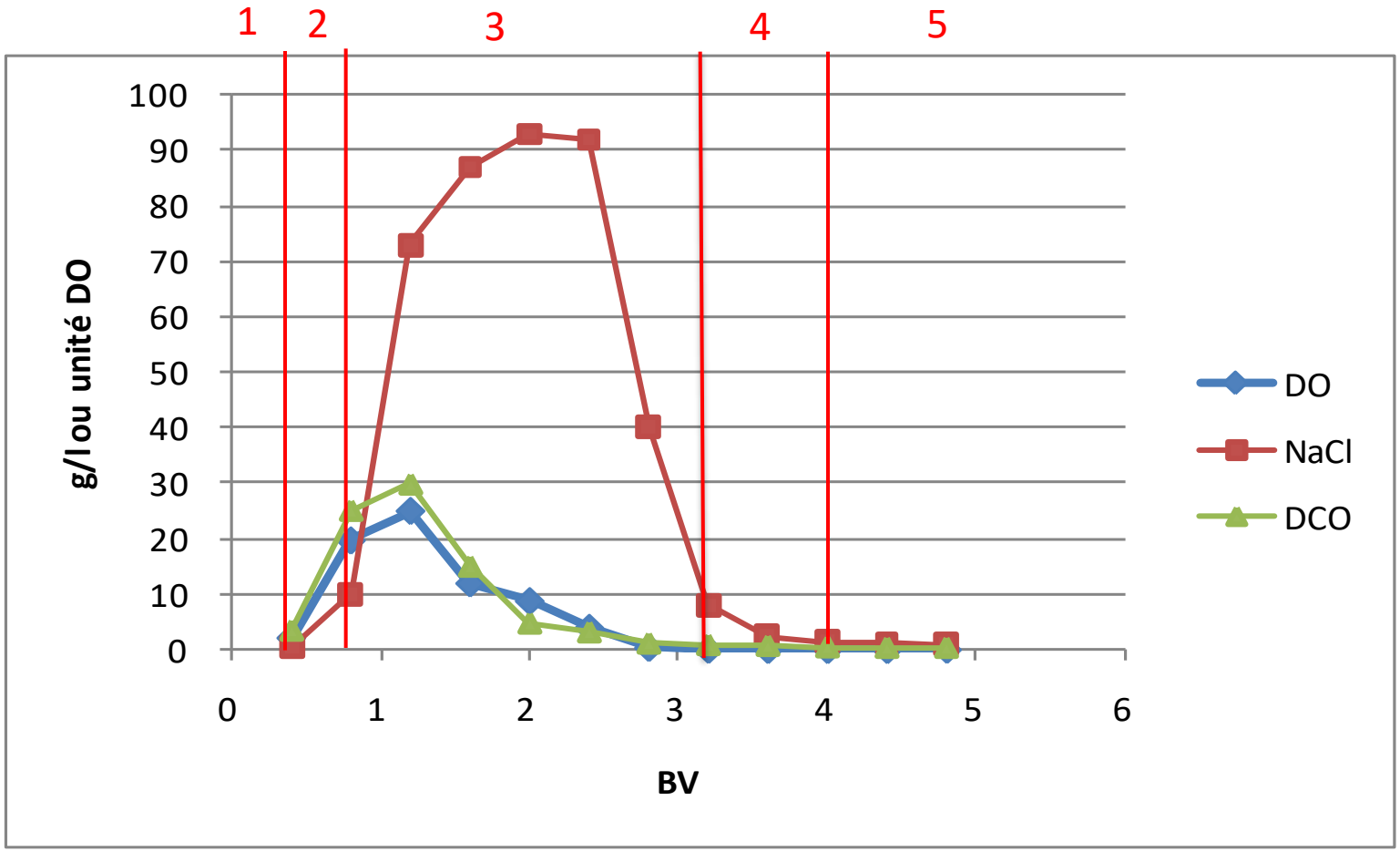
- Basic brine: NaCl 100 g/l + NaOH 5 - 10 g/l
- Regeneration level: 150 – 200 g NaCl/lres,
  # 2,5 – 3,0 eq/lres
- Temperature : 60 – 80 °c
- pH : 12 -13



REGENERATION MECHANISMS

- Osmotic chock
- Decrease hydrophobic interaction
- Ion exchange Cl capacity: < 0,2 eq/lresin

TYPICAL ELUTION PROFILE

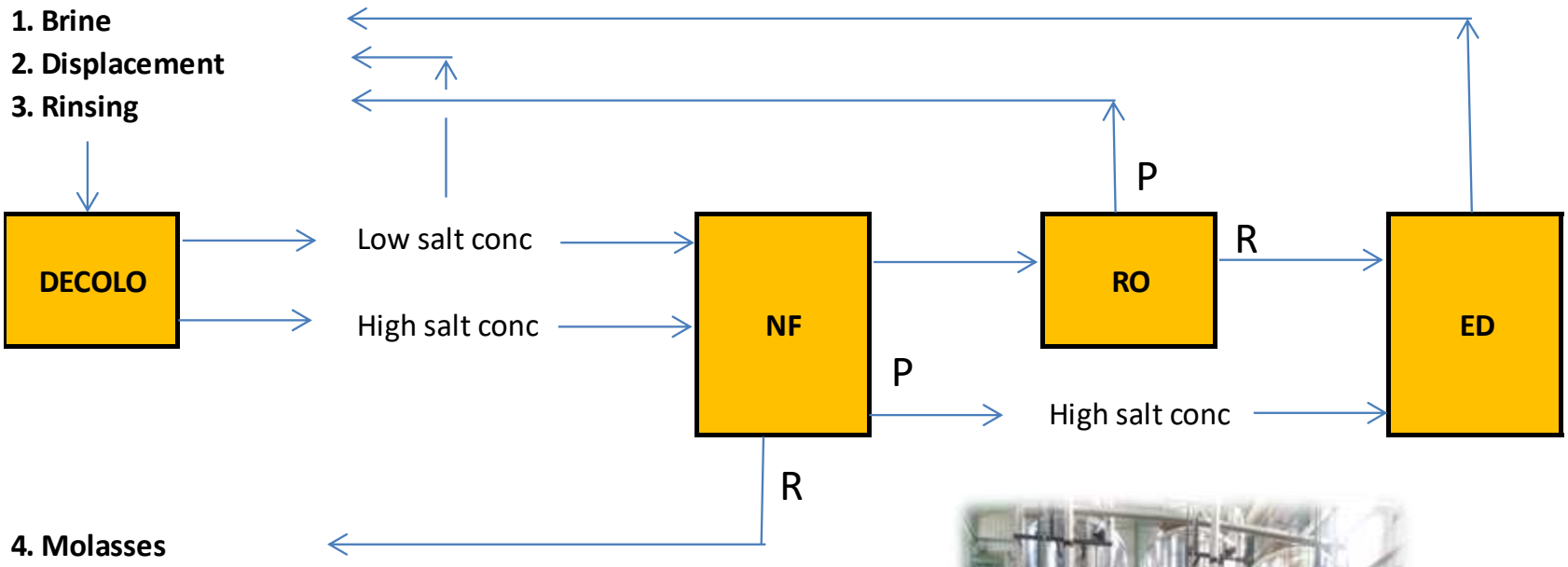


1- Recoverable water
2- Salty colored water
3- Colored Brine
4- Salty water
5- Recoverable water

Sugar Industry – Decoloration line

OPERATIONS

EURODIA PATENTED PROCESS



PERFORMANCES

- « No » brine consumption
- « No » waste discharge from resins regeneration
- « No » water consumption
- +/-10 times less energy consumption compared with evaporator option

OPERATIONS

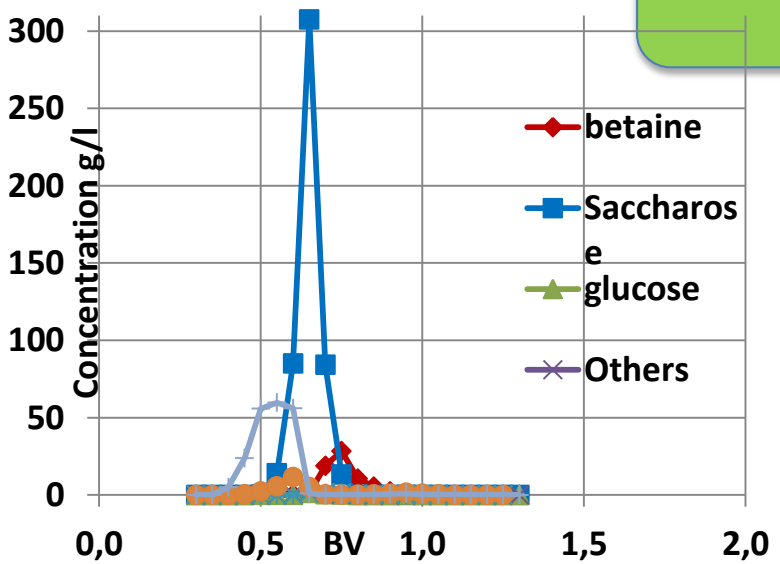
MOLASSES → ETHANOL

CLARIFICATION : Solids/Liquid

PURIFICATION : DEMINERALIZATION

FRACTIONATION

- SUGAR
- BETAINE



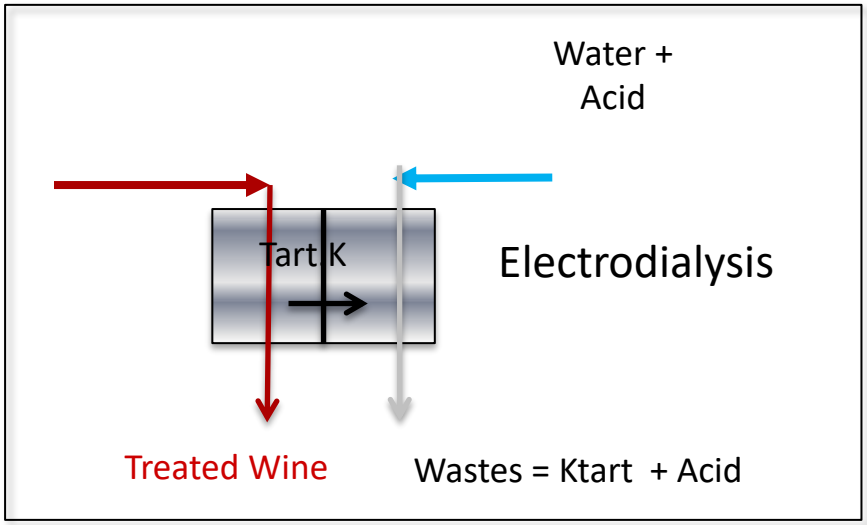
Sugar Industry – Decoloration line

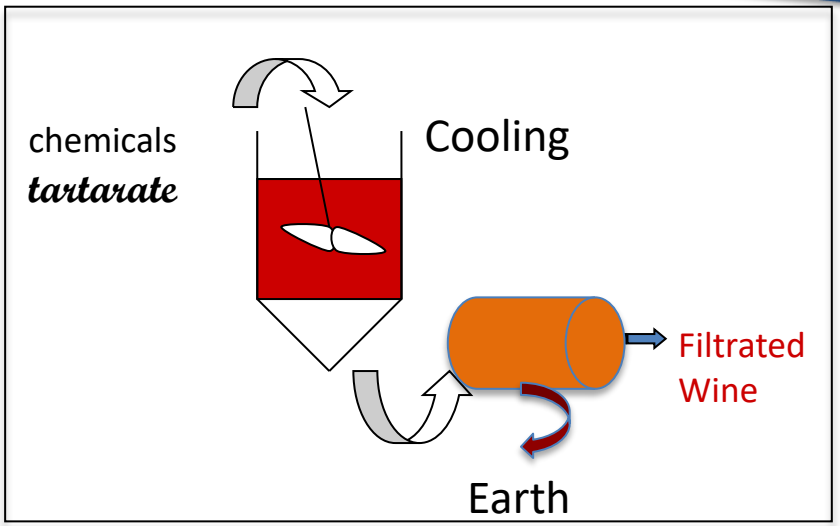
WINE INDUSTRIES
Wine tartaric stabilization

WINE STABILIZATION WITH ED MARKET IS GROWING!

- Over the last 15 years, ED has been extensively used for the Tartarate Stabilization for all types of wines.
- By end 2015, 200 plants in operation with 600 stacks: in France, Italy, Spain, Portugal, Germany, Australia, New Zealand, South Africa, Canada, USA, Russia, Argentina, Brasil
- Total volume of treated wine by ED : 800 million Liters/year (around 3.5% of world-wide production)
- **ED (wine stabization)-EDBM(pH adjustment) = SUBTRACTIVE Technologies : No chemical addition**
- **ECO-FRIENDLY Method**

Wine Industry – Tartaric stabilization

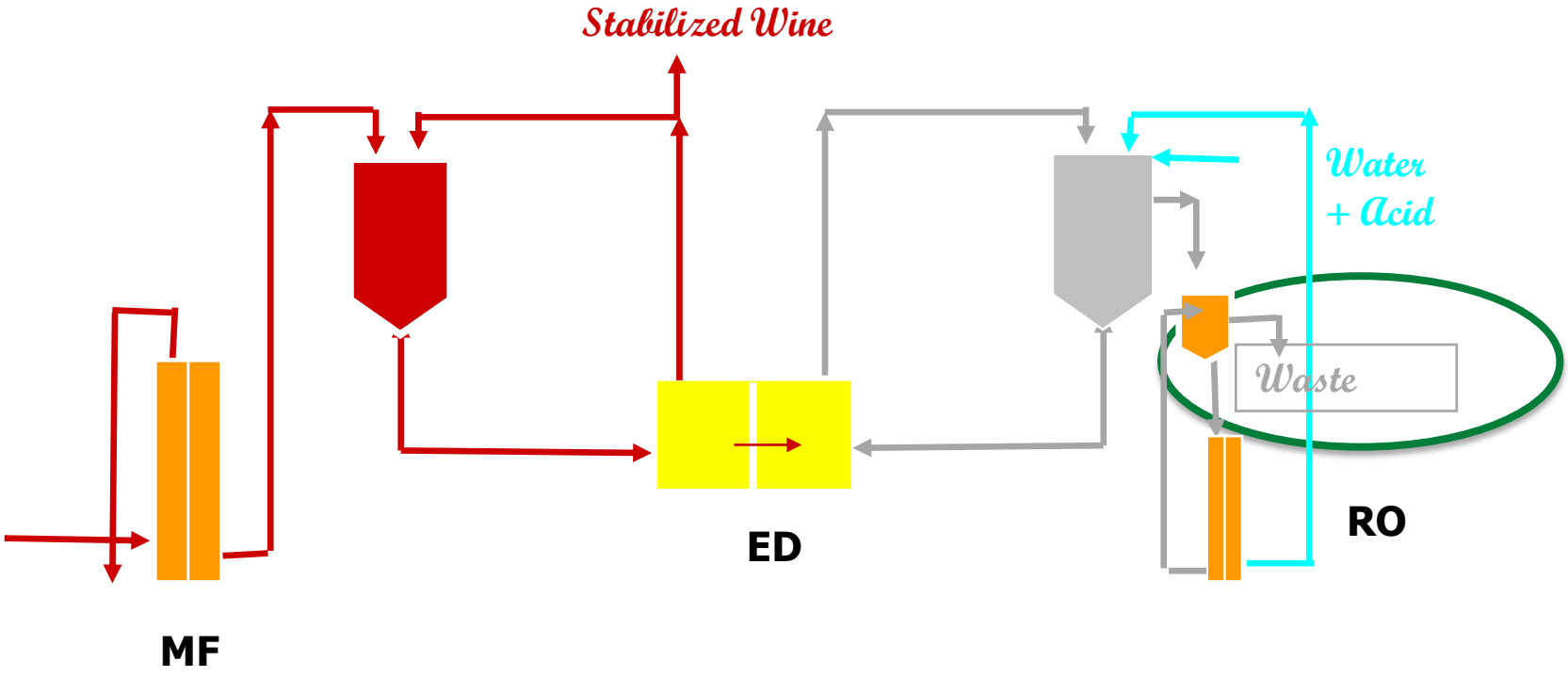




15 to 30 hL/h

120 to 240 hL/h

- PROCESS IMPROVMENT : Reduction of water consumption
- ED combined to Reverse Osmosis (RO)



- Performances of commercialized units : ED+RO
  - 50 to 70 % water recovery
  - Consumption : 5.5 L /hL wine including CIP (for a stab. rate of 18%)

Optimized process for wine stabilization : *ED + RO*

- Water consumption : 5.5 L/hL Wine for 18% stabilization

  50% to 70% water recovery – commercial unit
- Electricity consumption : 0.4 kwh/ hL wine as maximum

  8 times lower than cold stabilization
- Waste : RO retentate + CIP
- No wine losses

Perspectives : to reach “zero waste” with high pressure RO.

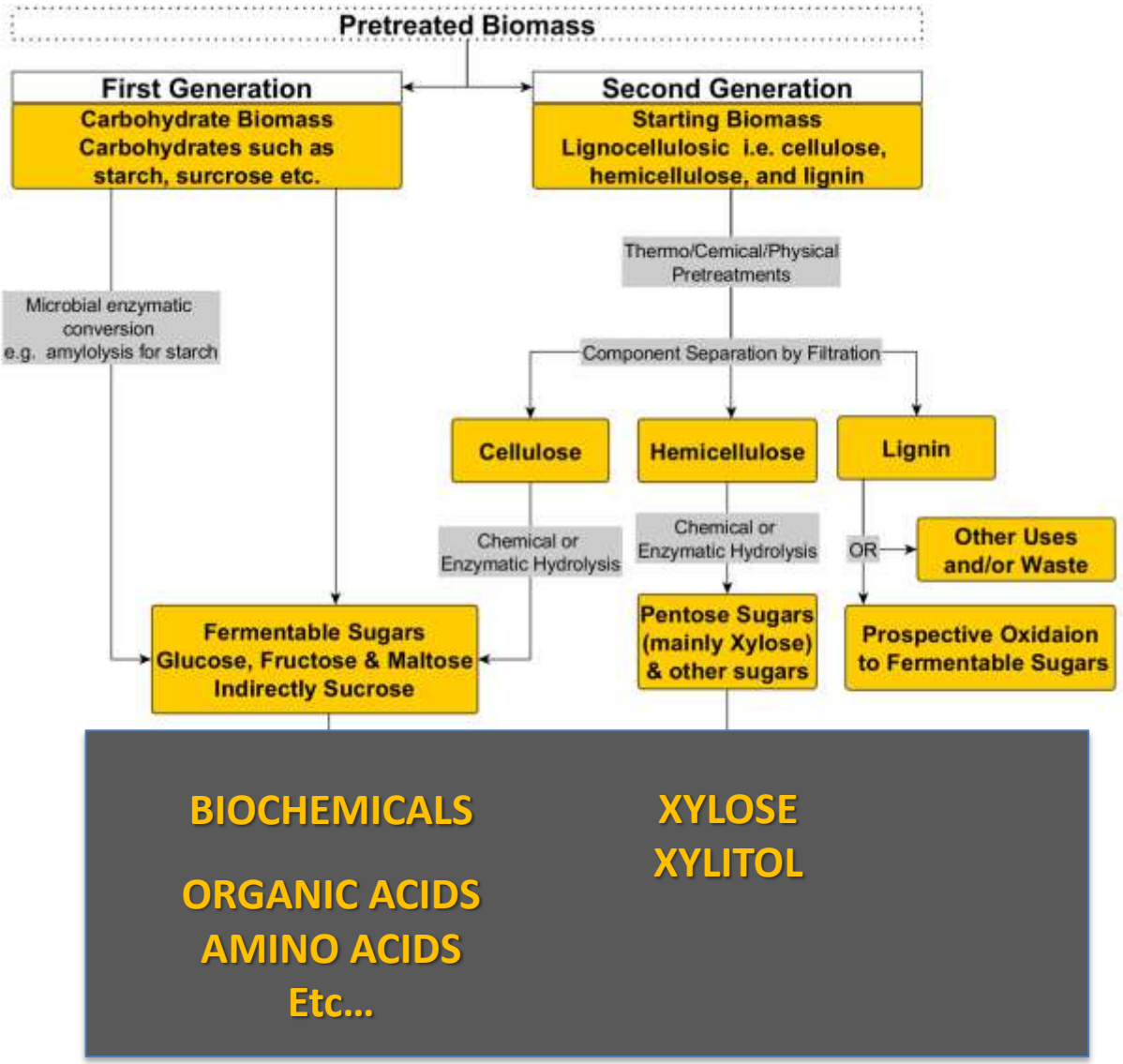
First results : 98% water recovery – Tartrate in crystal form – valuable product

AGRO-INDUSTRIES
2G Sugars Production

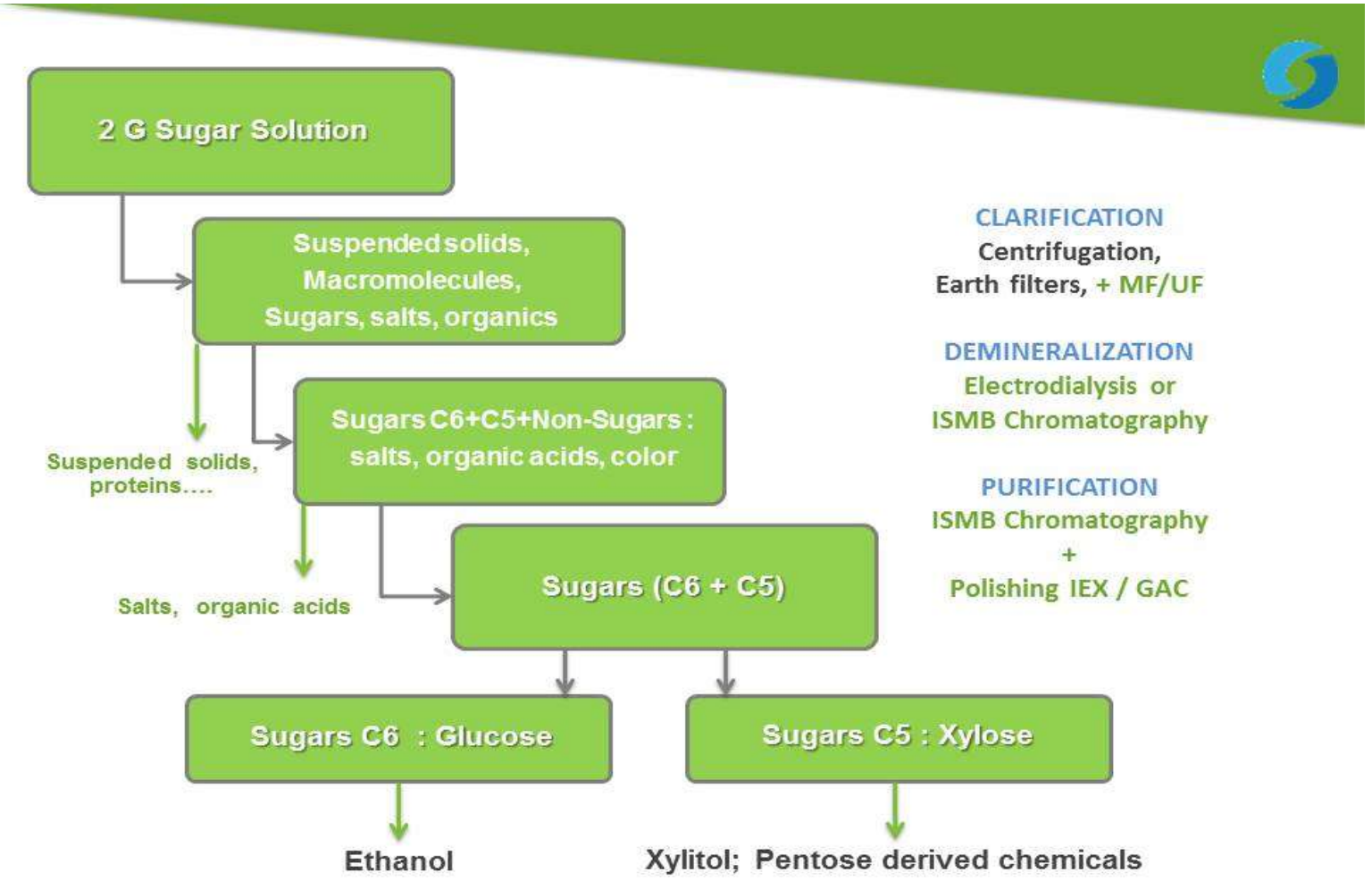
Biomass Fractionation

Biomass Fractionation for BIOCHEMICALS production is different from bioethanol production where mixed C5/C6 can be fermented

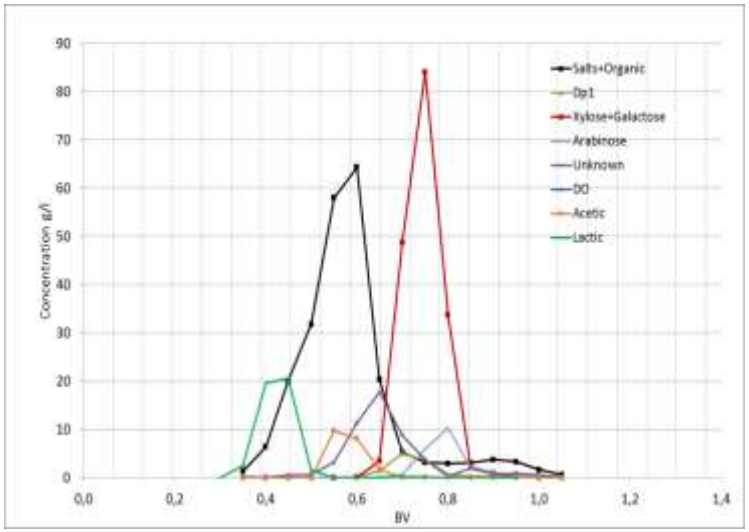
Necessity
to separate lignin / C5 / C6
(e.g. C6 only has interest
for most organic acids,
while C5 can lead for instance
to the market of Xylitol)



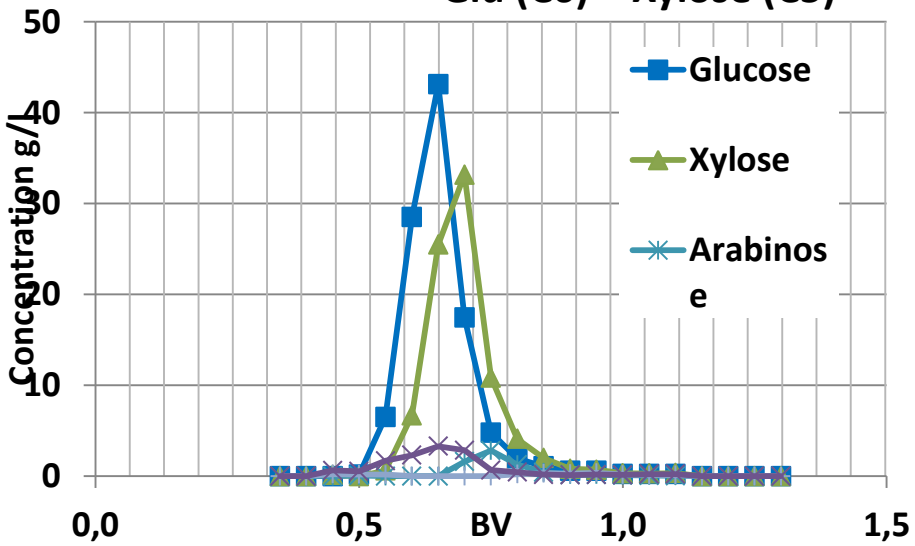
Agro Industry – 2G sugars Production



Non Sugar – Xylose (C5)



Glu (C6) – Xylose (C5)

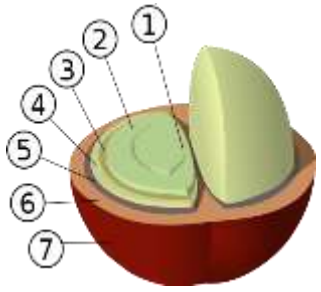


In the process of coffee production various residues are obtained. Biomass residues can be categorised into three main groups[5]:

1) Primary biomass residues, available at the farm; branches, stalks, leaves, prunings, and uprooted crop
2) Secondary residues: seed hulls, pulp, and chaff
3) Tertiary residues: spent coffee grounds SCG.

Secondary residues

The fresh coffee beans are liberated from the fruits releasing coffee pulp (29% dry weight), mucilage (5%) and coffee hulls (12%) in a sequence of wet and dry processing steps. The mucilage is either mechanically removed or through fermentation. The weight percentages may differ depending on the variety of coffee



1: center cut
2:bean (endosperm)
3: silver skin (testa, epidermis)
4: parchment (hull, endocarp)
5: pectin layer
6: pulp (mesocarp)
7: outer skin (pericarp, exocarp)

Coffee Pulp valorization

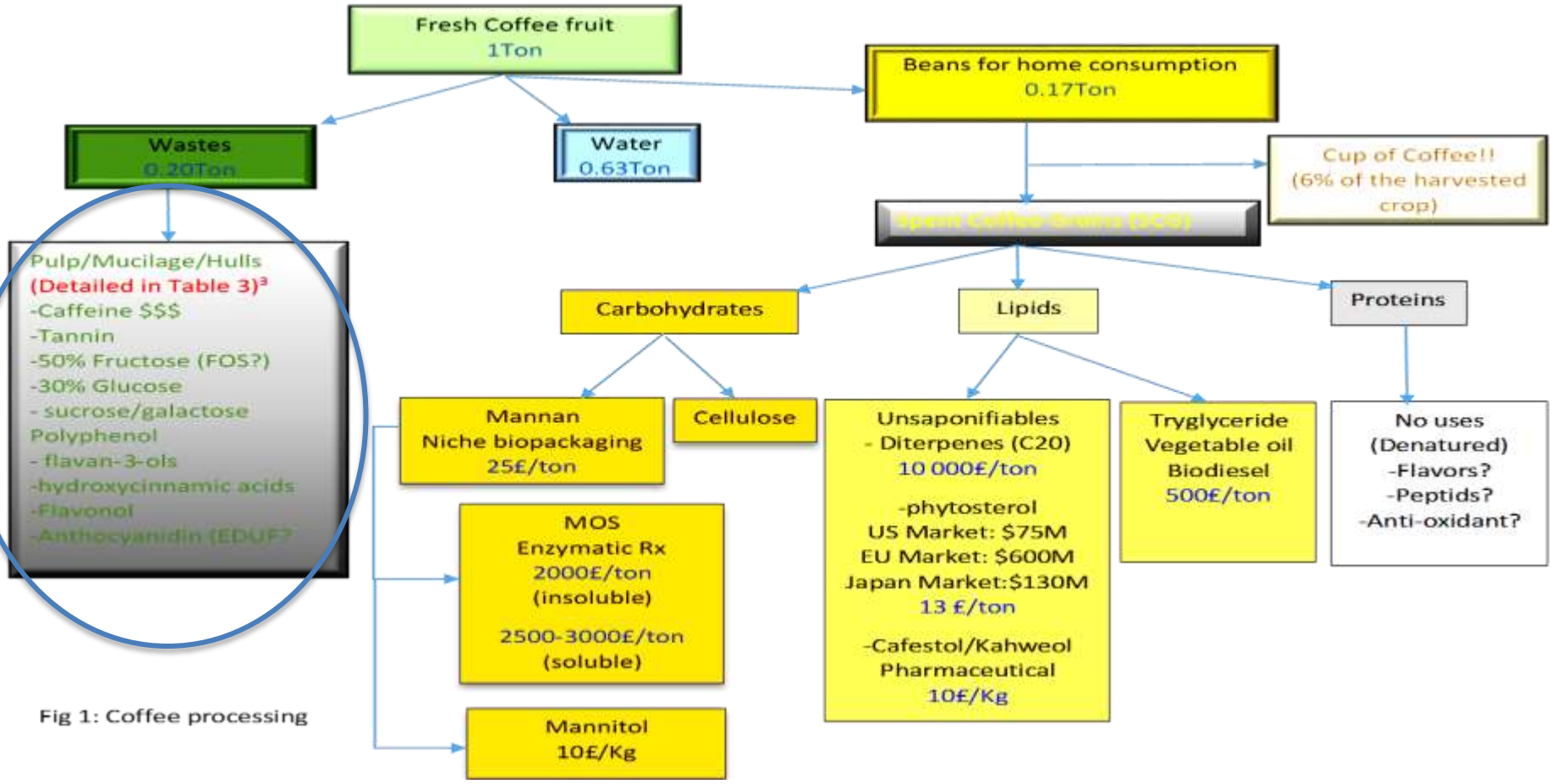


Fig 1: Coffee processing

CONCLUSION and PERSPECTIVES

- The key of success :
  - To Know the end value of co-product
  - Combine properly each technologies (process approach)
  - Complex process
  - Next step : give a value to this “natural” molecules

THE OPTIMAL PROCESS SOLUTIONS

Thank you for your attention!!

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