

## Filtration Application in Production of Liquid Sugars

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### Abstract

One of the separation methods with no phase changes is filtration which defines as separation of a liquid part by passing it through a porous matter with yarn that keeps solids on it (retentate) and liquid can pass through it (filtrate). In a membrane process, commonly two phases is available which have separated physically by a third phase (membrane). Different present filters include disc, net, sand, vacuum filters & reverse osmosis, nanofiltration, ultrafiltration, microfiltration, dialyze and eletrodialyze. Moreover the mechanism is sieving, surface filtration, depth filtration. These mechanisms depend on type, structure, membrane material, absorbance among particles.

**Keywords:** *Filtration, Liquid sugars*

### Introduction

First time, the difference among penetrate ability dependent to non-isochronism reported in 1845. Microfiltration produced commercially regarding bacteriologic labs in recent of 20th century. In 1975, membrane filters introduced. First non-isochronism membrane built in 1960 and its demanding in dairy industries develops in 1970s. Filter types

#### Self-cleansed filter

Removing particles size 10-2000 $\mu\text{m}$ , self-automated cleaning ranges 10-1000 $\text{m}^3/\text{h}$ .

#### Disc filter

Removing of particles size 50-400 $\mu\text{m}$ , capacity 1-800  $\text{m}^3/\text{h}$

#### Mesh filter

Removing particles 50-1000 $\mu\text{m}$ , manual or semi-automated cleansing system, capacity ranges 1-150  $\text{m}^3/\text{h}$ .

#### Sand filter

Removing turbidity and suspender particles up to 80 $\mu\text{m}$ , vessel capacity 40cm-3m, vessel is made of fiber glass or steel.

#### Vacuum pump filter

Prevention of particle entering up to size 2500 $\mu\text{m}$  to pump, continuous and automatic cleansing system, capacity ranges 100-1200  $\text{m}^3/\text{h}$ .

#### Filtration

Removing particle with size 2-20mm, manual or semi-automated cleansing, and connections' size 2-20 inch

#### Hydrocyclone

Removing high molecular weight particles, manual discharging system or/with control valve, connections size ranges 2-8 inch.

#### Different membrane filtering systems

**Reverse osmosis:** This membrane is used to separate ions and lower molecular weight salts than solvents.

**Nanofiltration:** in order to remove particles larger than 10  $\text{A}^\circ$  is used.

**Ultrafiltration:** this membrane is used to separate macromolecules with size ranging 20-100  $\text{A}^\circ$ .

**Microfiltration:** separation particle (size range from 0.2-20 $\mu$ ).

**Dialyze:** small parts pass with more pressure than big parts through a semipermeable membrane due to the difference in concentration.

**Electrodilyze:** separating ions with opposite charges (Esmaeil zadeh Kenari, 2010; Hinkova et al, 2000; Zfcui, 2010).

#### **Separation mechanism**

**Sieving or surface filtration:** when holes are smaller than particles' size.

**Deep Filtration:** holes are more than particles' size.

#### **Results and Discussion**

In sugar industry, the main stage of removing impurities is filtration. Regular Carbonatation create lots of environmental problems thus study about modern methods of membrane technology in order to improve current methods regarding reduction of environment pollution and increasing refining efficiency have been proposed (Berk, 2009).

#### **Crude syrup refining**

Cross flow of MF and UF has been used to reduction of lime in sugar beet industry.

#### **Refining of bagasse extract**

Membrane filtration can sterilize bagasse extract and removing suspended materials.

#### **Concentrating crude syrup**

The most ability is reducing energy, concentrating of thinned syrup using membrane filtration. This system can concentrate syrup with %12-14 and converts it to syrup with %30 of solid material.

#### **Vacuum filtration**

Impurities are separated by precipitation process. In new method, filtered syrup refined by UF thus purities increases 3 times.

#### **Application in refined syrup**

Regular refining mudules and UF system increases syrup quality. In this method after softening, syrup passes through membrane filtration, thus final cleared and refined syrup obtains.

#### **Application in refining of concentrated syrup**

Passing concentrated syrup from NF system with 20-50 A° holes, not only bleaches syrup but also increases crystal forming ability in exudation phase.

#### **Application of bleaching by ion exchanging**

To reactivate resin, basic water uses which cause to create sewage contains sodium chloride. To solve this problem, saline with a spiral filter uses. The amount of particle passing depends on the length of their holes, presence forces, liquid flow intensity,

and liquid concentration, the volume of passing liquid, their thickness and their material.

#### **Fouling**

Irreversible of protein aggregation, minerals, microorganisms, fats, suspended solid particles may cause to change in filter efficiency as fouling reduces outer flow during time, filter shelf life, and increases production costs and filter destruction (Berk, 2009). With respect to this point that fouling is an inevitable phenomenon time intervals need to plan for cleansing by some cleaning agent like acids, bases, surfactants and backwashing process (Hakimzadeh, 2006; Shahidi et al ,2006).

Applying of filter has benefits including flexibility in changing of geometry shapes, modules and their size, no need to phase changing, filtration of heat-sensitive solutions and requirements to solvent in order to separation is less than other methods.

#### **Appropriate filter properties in liquid sugar technology**

A filter must be characterized as follows;

- Easy cleansing of precipitations
- Low requirement to human source
- Occupies less space
- Less requesting spare parts
- No changes in product nature

#### **All filters related to sugar industry**

##### **Vacuum filter**

This vacuum is a rotating cylinder which submerges in a chute vessel and made of rectangle shaped sheets with lots of holes and covered by filter. In each rectangle, there is a hole connected with a pipe terminated to a vacuum pump. Saturated syrup enters to chute vessel and vacuum suck syrup through filter cloth into the cylinder. Obtained mud forms a layer around cylinder and cleansed by water sprays.

##### **Under pressure filter**

A so-called system in which frames have wrapped every other in filter cloth. Each sheet contains a hole allow syrup (and its mud) enter to the system, then syrup enters to empty frames, crossing filter cloth holes and becomes filtered.

##### **Mechanical filter**

This filters which work with low pressure are consist of sheets with a pipe over them in a filter bag. When syrup filters, coarse precipitation particles separate from syrups

##### **Candle filter**

Candle filters are latticed pipes wrapped in cloths which are placed in a cylinder with shaped cone terminal. Syrup passes through filter with pressure and its mud leave behind cloths. Different types of liquid sugar, invert sugar, liquid fructose, liquid saccharose, consumed by customer. Invert sugar,

named also artificial honey, widely applies in food industries like candy, jam and chocolate production. Liquid glucose is a refined solution composed of glucose; dextrose and maltose produced through hydrolyze of acid and enzyme, and sometimes by fructose isomeration. It plays as anti-crystallization in bakery, biscuit, confectionary, chocolate, candy, beverages and ice cream. High fructose corn syrup is one of the commercially products which widely uses in food and pharmacy industries. High fructose corn syrup with special smell has similar functional properties to sucrose.

This sweetener can be used in all food required (containing high moisture amount) to be sweetened. High fructose corn syrup with %10 less than sucrose cost consumed in fermentative industries, beverages etc. Saccharose liquid sugar produced through dissolving sugar beet or sugar cane in water, bleaching and finally packed.

Enriched Maltose syrup consumes in candies and fermented products due appropriate color creating, texturizing and flavoring properties. Glucose syrup is produced by both acidic and enzymatic method where the former has obsolesced (Esmailzadeh, 2009; Berk .2009; Hinkova et al, 2002).

Main stages of glucose production by enzymatic method includes starch flowing, sugar making by enzyme, filtration, bleaching, refinery using resin filters, glucose concentration (evaporator) and packaging.

#### **Liquid Glucose Production Using Acidic Method**

Including starch solution preparation, adding acid, hydrolyze, neutralizing, cooling, first press filter, bleaching, second press filter. Impurities separate by refining soil. Press filter include some sheets and frames where filter cloths cover them. Filter cloths cleansed after removing impurities and soil when mixture of hydrolyzed syrup and perlite passes through them.

In second press filter, separation of impurities and protein completes at 85°C. Press filter characterizes as 200m length, width 80m and height 120m. Indeed, this device uses to separate solids from liquids in different industrial processes. The most important benefits of press filters in comparison with other filtration systems are facilitating, low keeping cost and high efficiency (albeit its efficiency depends on solution viscosity, solution temperature and particle diameters (Takhtchin and Kheirandish, 2010; Afcui et al, 2010).

#### **Production stages of liquid fructose**

This process includes starch syrup, moderation of syrup temperature and heating syrup, enzymatic hydrolysis, glucose isomerization, separation fructose from glucose, concentration by resin exchanger and glucose syrup filtration. Resulted

glucose syrup screened in order to removing of impurities.

#### **Syrup bleaching**

Since glucose syrup has a yellowish color due to some yellow pigments, syrup passes through activated Carbone filter in order to its color to be removed. Pieces of activated Carbone place in structure frames. The small porosities on Carbone surface can place lots of fine articles in itself. High density of Carbone along with the presence of lots of microscopic pore considers the reason of its application in bleaching of syrup. The reason of activated Carbone

#### **Resin filters**

Body of resin filters is similar to pressure filters. To prevent leaving resins, several sand coarse layers or anthracite is contrived under the bottom of device. The only problem of this system is its backwashing thus more regular meshy placed uses. The presence of weak ions close to strong ones increases ion exchanging and by mixing cationic and anionic resins particles, an ion exchange system.

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