SOY PROTEIN CONCENTRATE TECHNOLOGY

Enhanced Proteins from Soya

SOPA THE SOYBEAN PROCESSORS ASSOCIATION OF INDIA

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INTERNATIONAL SOY CONCLAVE

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Brilliant Convention Centre, Indore

CROWN EST. 1878

SPC Product Overview

What is it?

- Defatted Soy Meal with soluble carbohydrates as well as some flavor compounds removed.
- Typically, 65-73% protein on Moisture-Free Basis (up to 90% typically 70% PDI)
- Very different than Soy Protein Isolate (SPI) (90%+ PDI)

Used in:

- Lunchmeat
- Meat alternatives
- Ice cream novelties
- Dairy replacements
- Nutritional beverages
- Soups & sauces
- Nutrition bars & cereal

Used to:

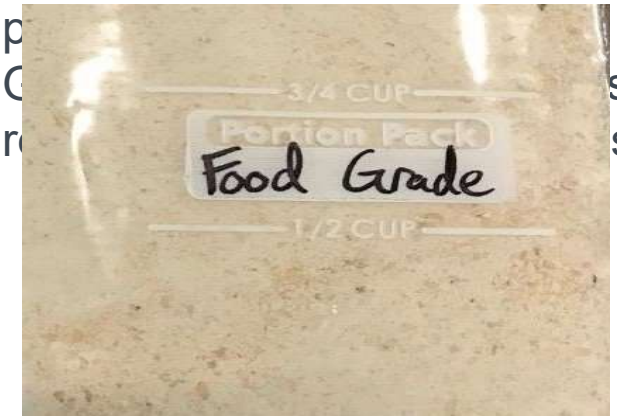
- Improve texture
- Increase water retention & juiciness
- Improve emulsification
- Maintain or improve nutritional values
- Cost reductions

SPC Product Overview

Can be divided into two types:

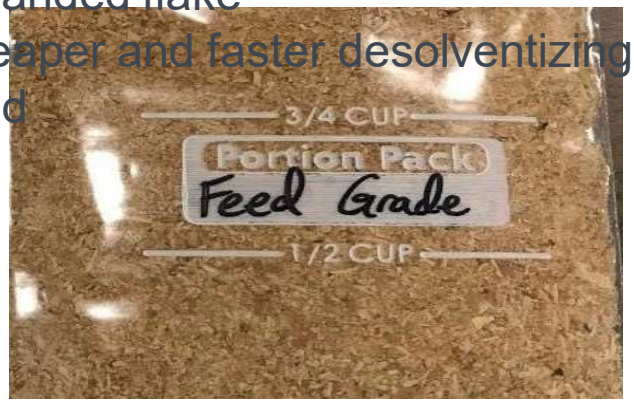
FOOD GRADE

- For Human Consumption
- Lighter in colour
- Lighter in flavor
- Starting material “white flake”
- Model IV preferred due to poor p
- C ses r s

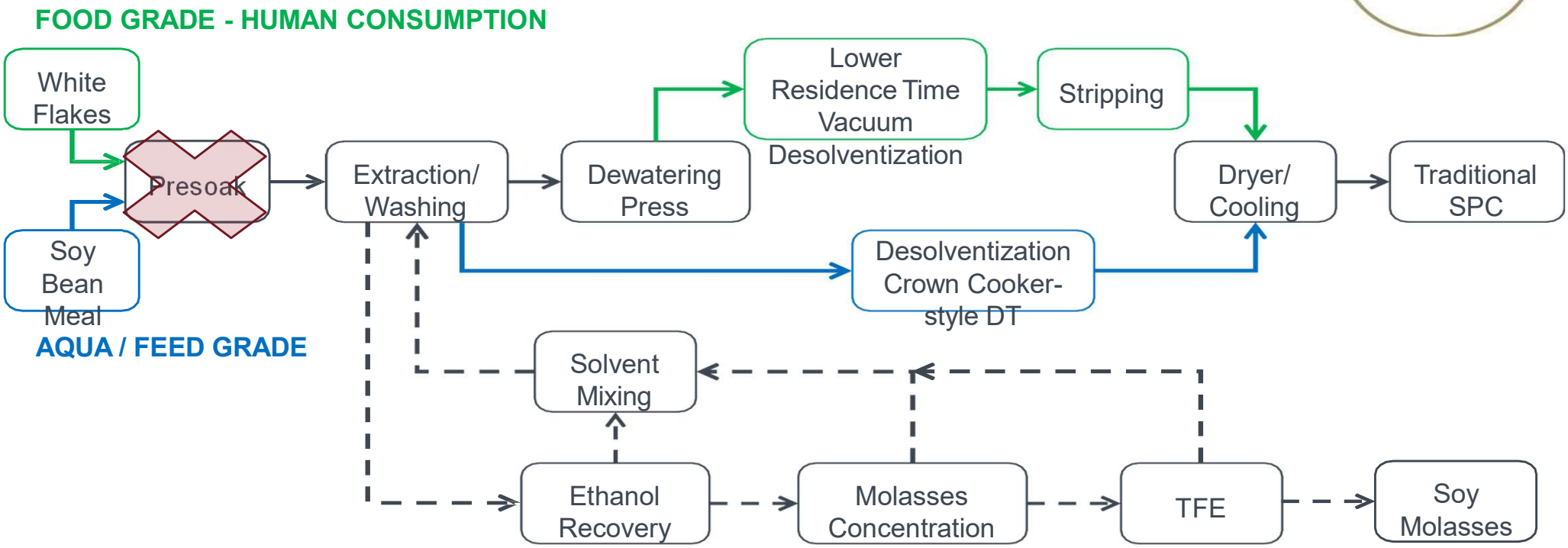


AQUA/FEED GRADE

- For Animal Consumption (typically fish food)
- Darker colour
- More toasted flavor
- Starting material “DT meal” or expanded flake
- Cheaper and faster desolventizing used



Basic SPC Flow Diagram



SPC Product Overview

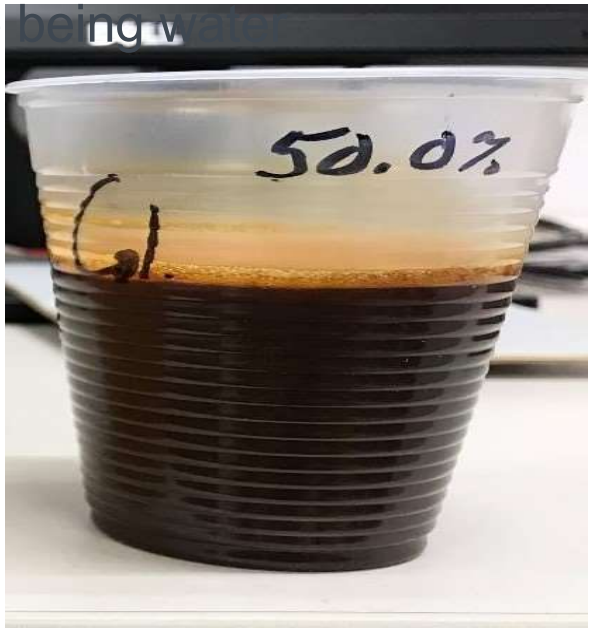
Byproduct – Soy Molasses (No SPC plant should start without a plan for the Molasses!

-Contains water and ethanol soluble compounds, mostly sugars

-Typically concentrated to 50% solids, the balance being water

Potential Uses

- Liquid Feed for Ruminant Cattle
- Source of Sugars for Fermentation
- Mix with Hulls
- Add back to rations for Piglets
- Food Additives
- Boiler Feed for Heat Recovery (High Calorific Value!)



Crown's plant protein expertise runs deep

- 70 years experience in preparation, extraction & refining
- 50 years of providing custom engineered protein concentrate solutions and equipment
- 25+ projects for food, feed and aquaculture completed worldwide
- Our Plant Protein Concentrate Process allows you to produce protein from soy, rapeseed, canola and other oilseeds
- US Innovation Centre with dedicated Plant Based Proteins Line to custom process, design, develop, test and scale relevant product lines (Including Soft Seeds and Specialty Applications) .

CROWN SPC PLANT

- Plants Operating Worldwide up to 600 MTPD, with **SPC experience starting in 1973**
- **Model IV Immersion Extractors** operating on SPC. No Screens (**No Cleaning**), No Pre-Screening, Pumps or Hoppers; designed and Commissioned for up to 500 MTPD.
- **Vacuum Desolventising Technologies** to maximize Protein Quality and Colour
- **Distillation** designed to maximize uptime with plants exceeding **345 days run-time** per year including time for cleaning (2-4 times per year or less). Utilizing a forced circulation approach in the evaporators – **NO evaporation takes place inside the heat exchangers**.
- **Patented Full Miscella Clean-Up Package** to be proposed as Option to remove contaminants, maximize yield and keep Distillation on-line longer for improved productivity.
- Crown Steam Economization Technologies included as Standard - proven **Low Steam Consumption** requirements.

Key Advantages

CROWN
EST. 1878

OPEX & Quality - SPC

OPERATING EFFICIENCY

- Crown Extraction Plants require no more than **two people per shift** to monitor and control the entire plant
- Zero effluent during production. '**ALL WATER' in the process is reused** without affecting product quality.
- **Minimal ethanol loss** – essentially **all** ethanol is recovered in the process. Recovered ethanol is **clean** and continuously re-used in the process.
- Steam efficiency – Crown's fully integrated plant with numerous steam recovery and economization features provides the highest steam efficiency on the market.
- Recent Operating Plant Data suggests that with the utilization of Crown model IV Immersion Extractor, solvent to feed ratio could be approaching 3 to 1 – this would translate to up to **20% reduction in steam consumption.**
- Crown Model IV Immersion Extractor provides lowest electrical consumption as there are no pumps and the drives are smaller. 1.5kW x 6 < (7 Motors x 3 Extractors) = 31.5kW 'V' 192.5kW Installed Power for alternative Percolation Extractor Type at the same capacity.
- **Steam Consumption –** As low as 1,000 Kg/Tonne of Plant Feed Material

Extraction

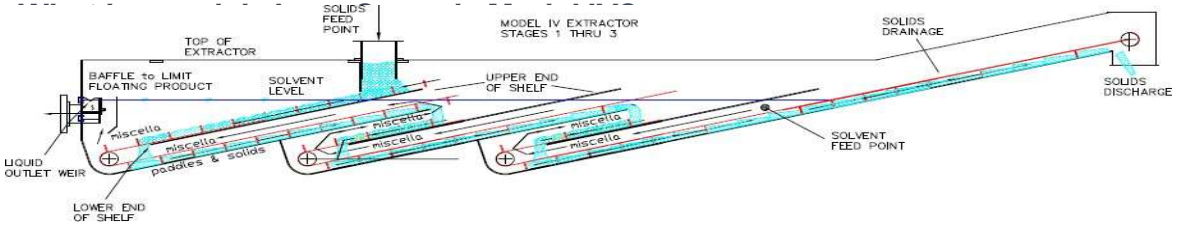
The Solvent: Aqueous Ethanol

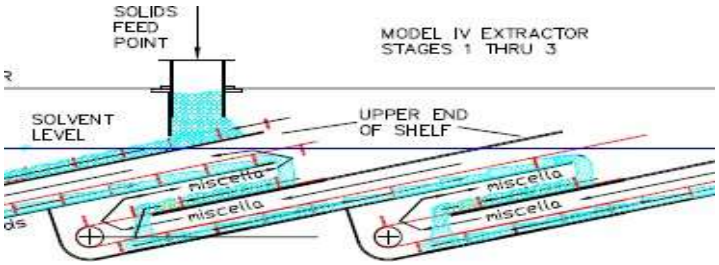
- **Hydrous Ethanol**
  - Water does the extraction, ethanol keeps things free flowing
  - Too much ethanol → poor extraction or high solvent ratio
  - Too much water → meal becomes difficult to handle (sticky, heavy, difficult to dry, etc.)

- **Mixed vs. Separated**
  - Water and ethanol are completely mi
  - Unlike the Work Tank in a Hexane Pla SPC Solvent Mixing Tank intentionally mixes, measures and adjusts the concentration of EtOH

Crown Model IV Extractor

CROWN MODEL IV IMMERSION EXTRACTOR – A well proven Immersion Extractor utilizing the latest technology!





PERFORMS - As low as 3:1 solvent to flakes ratio to achieve a protein content of 70%+ on dry basis

- Solids are totally and continuously immersed in the solvent until final drainage
- Handles fine material (>400 microns) no problem. Feed does not need to be pre-screened.
- Solvent flows by gravity without pumps. Significantly lower OPEX than Percolation Extractors

Crown Model IV Extractor

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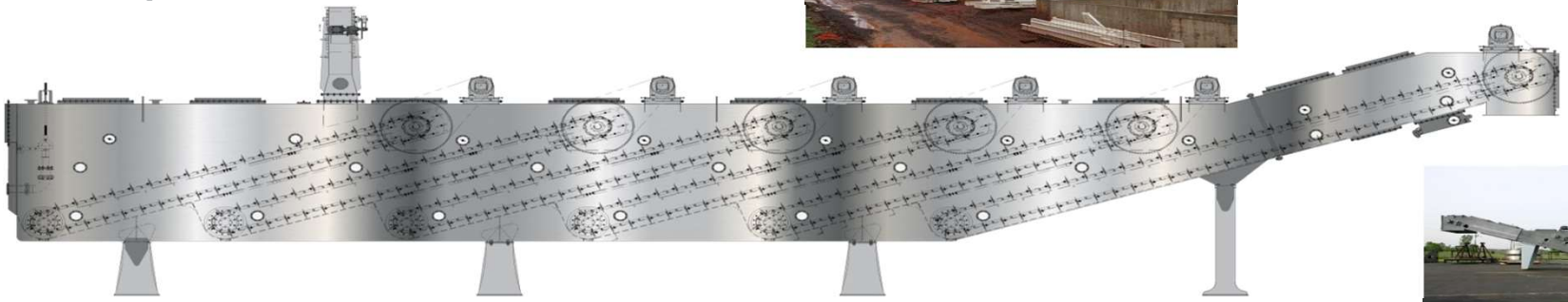
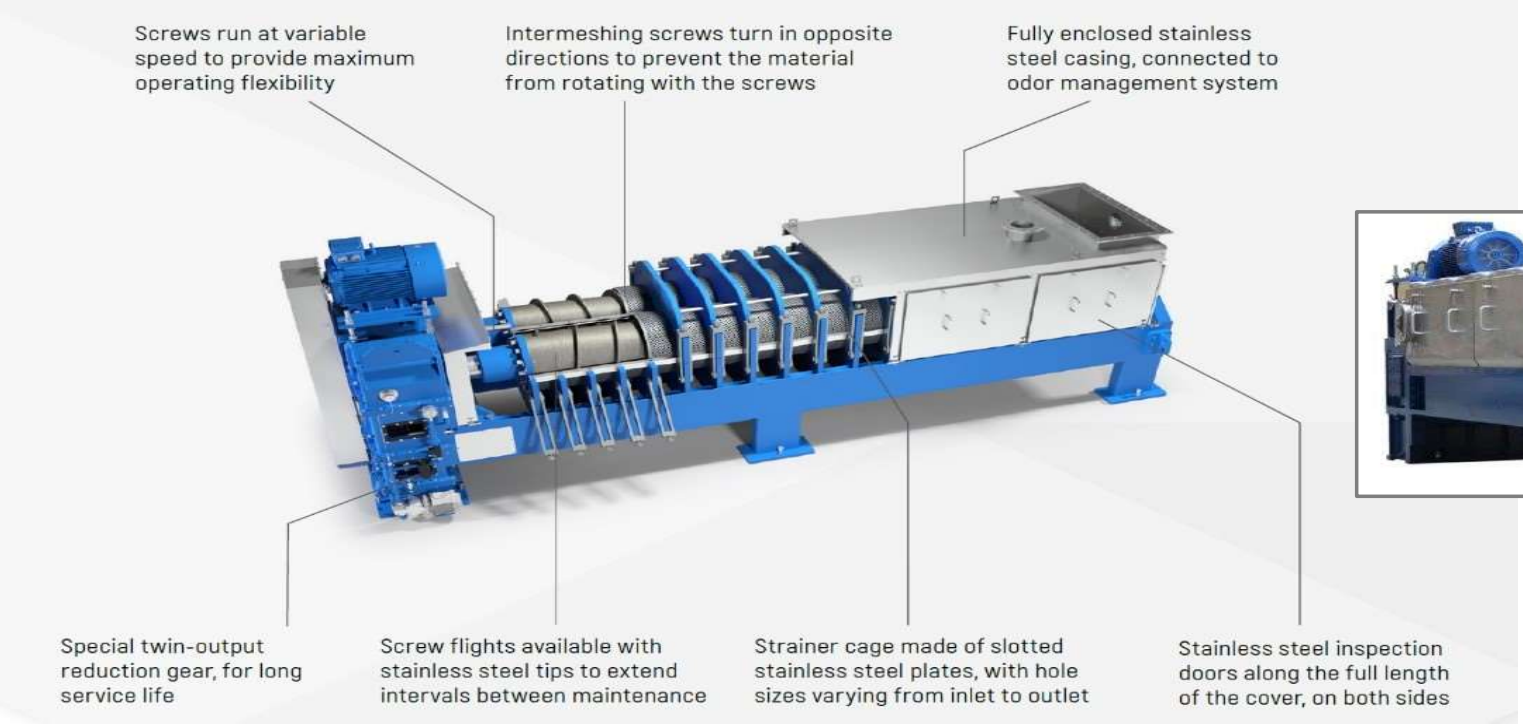
What is special about Crown's Model IV?



PROVEN – Robust, Simplicity by Design

- >24 model IV extractors for various applications have been installed since 1992. Typical chain speeds < 300 mm/min with almost no wear
- 8 Model IV Extractors process silica gel (very abrasive material compared to SPC), **5 processing SPC**. Many for over 25 years
- First spare parts sale for a machine that was installed in 1992 was made in 2012.
- All bearings can be accessed externally should maintenance be required. NO Internal bearings!
- Internal Sprocket & Chain replacement can be made without the Model IV being fully dis assembled
- The Model IV has closed end bearings on the bottom which would not leak even if they failed. Should there be a leak only a portion of the Model IV would actually drain. Smaller Sump Required

Dewatering Press (Food Grade Only)

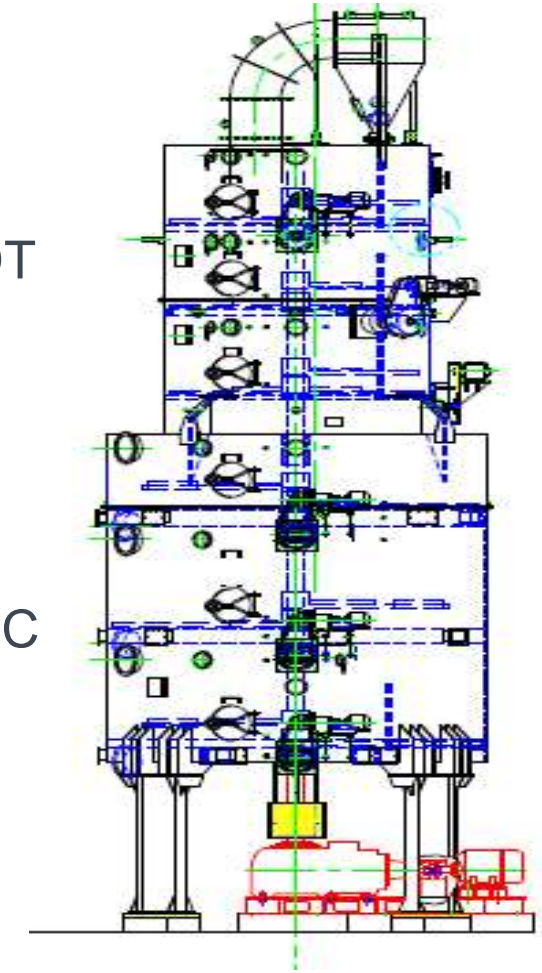


- Presses improve Product Quality
- Reduces plant steam consumption (reduces total volatiles to distillation)

Desolventizer – Food Grade SPC

- Short residence time
- Can operate under vacuum – lower operating temperature
- Short residence time and lower operating temperature translates to higher protein quality and lighter

Final Stripping – Food Grade SPC



- Stripping trays at the top are provided for final stripping of residual ethanol with the use of sparge steam
- The lower section is Dryer/Cooler (DC)
- SPC Light and Fluffy in the DC Section and Discharged as Soy Flakes for further Processing i.e Grinding, Texturizing, Extrusion e.t.c)

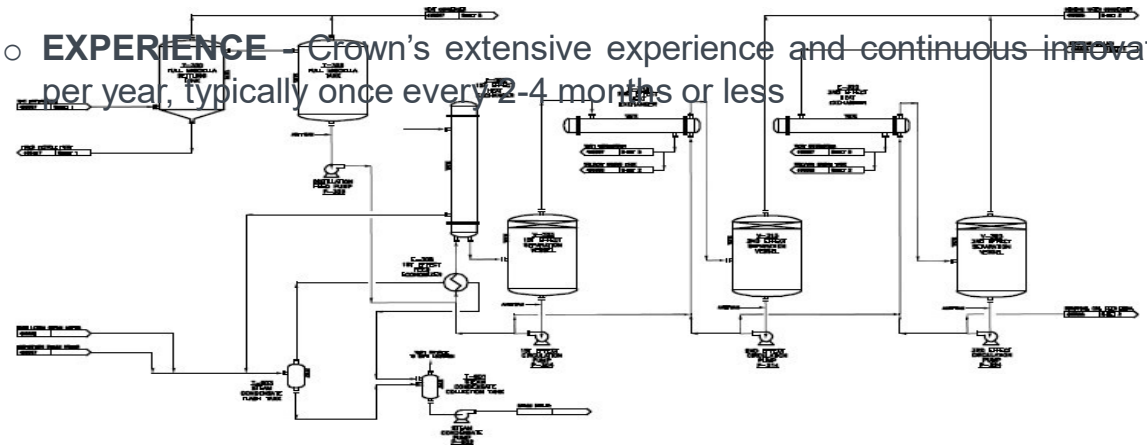
Desolventizer – Aqua/Feed Grade SPC

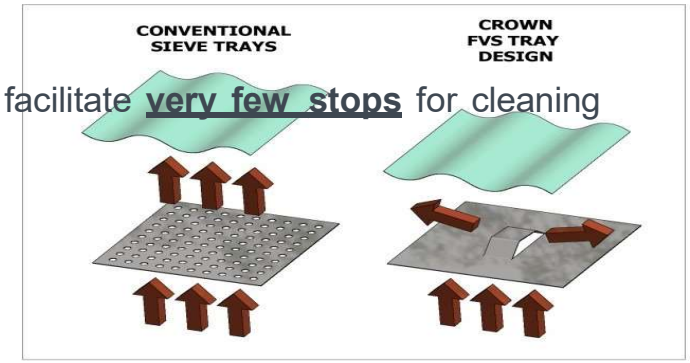
DT & DC with single shaft

- Desolventizers are sized based upon indirect heating
- Minimal/no sparge steam
- Ethanol content at the discharge <500 ppm

SPC Distillation - Stay on line longer

- **FORCED RECIRCULATION EVAPORATION -** High velocity ensures that evaporation does NOT take place in the heat exchanger keeping the Evaporators clean. No Dry Spots!!
- **MULTIPLE EFFECT EVAPORATION -** is efficient in it's own right, but Crown reduces steam usage by incorporating waste heat sources from around the plant. Integrated plant design to save energy.
- **FIXED VALVE TRAY STRIPPER -** Stripping the Soy Molasses to ppm Ethanol levels to keep the stripper clean.
- **MISCELLA CLEAN-UP SYSTEM -** Crown has developed and **patented Miscella Clean-up System** that further cleans the miscella and improves uptime. This miscella cleaning system is even more critical when processing alternate oilseeds such as Rapeseed and Canola
- **EXPERIENCE** - Crown's extensive experience and continuous innovations facilitate **very few stops** for cleaning per year, typically once every 2-4 months or less

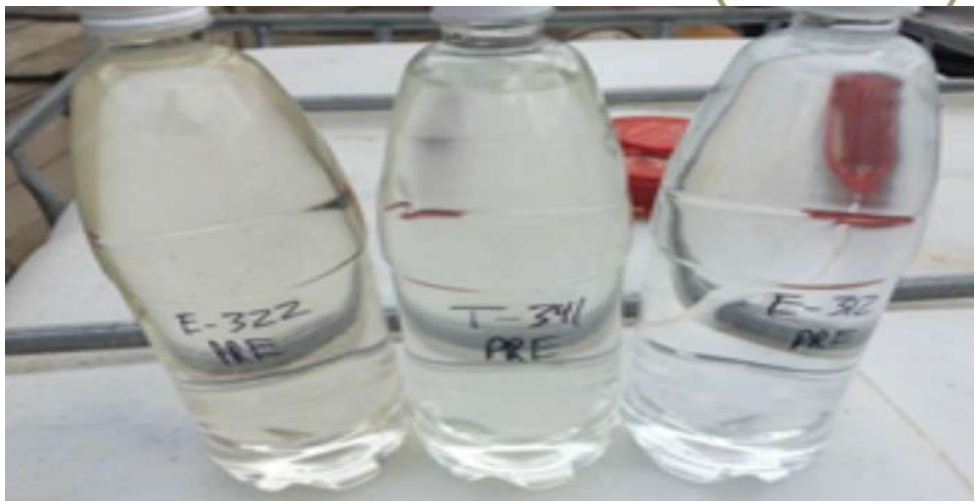




Distillation

- **Primary Objectives are:**
  - Recover Ethanol
  - Concentrate Molasses
  - Mix Solvent

- **Robust Design – minimize down time for cleaning**
- **Efficient – multi-effect evaporation, steam economization**
- **Zero Waste Water during Operation**



2010 ---------- 2020

DEVELOPMENT TIMELINE

- **Minimize Ethanol Losses**
- **Clean Recovered Solvent – better taste / blander product**
- **24/7 Operation**

Distillation System Latest Developments Optional System

- **Crown Patented Full Miscella Clean-Up Package** for New SPC Plant possible retro-fit to existing facilities.
  - System designed to reduce distillation system fouling by removing entrained solids, contaminants and impurities in Full Miscella.
  - Can **Maximize Yield** and keep Distillation **on-line longer** for improved productivity (Solids returned to Dewatering Press Line).
  - This Miscella Cleaning System is even more critical when processing alternate oilseeds such as Rapeseed and Canola.
  - First Installation Commissioned in 2021
  - Requires **chilling miscella** to approximately 15ºC prior to centrifugation
  - Developed for Soya and Rapeseed/Canola Protein Concentrate Plants

BEFORE
(Soya)

AFTER
(Soya)

Distillation – Stripping Column

Provides means to completely recover ethanol

- As low as non-detectable EtOH level in molasses

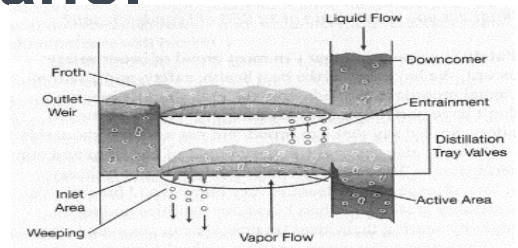
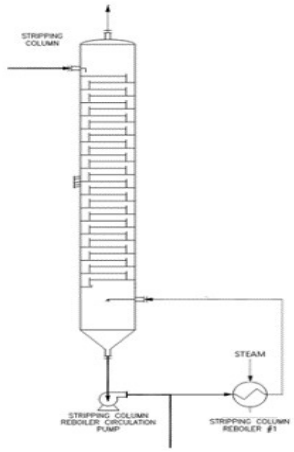


Figure 1. In a conventional cross-flow distillation tray, liquid moves down as vapor moves up.

Concentrates molasses to 30-40% solids

Forced Circulation Reboiler

- Potential for fouling is largely reduced

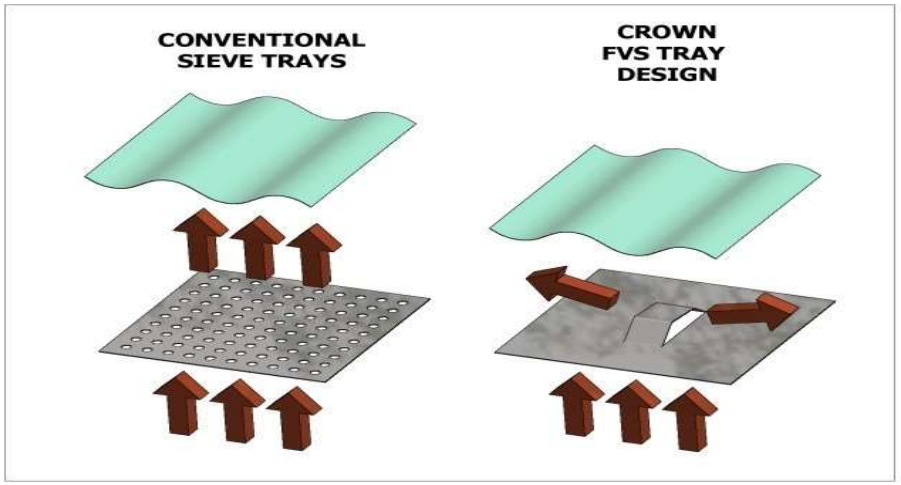


Internals – Fixed Valve Tray Technology

- Very effective in fouling service

Distillation – Stripping Column Trays

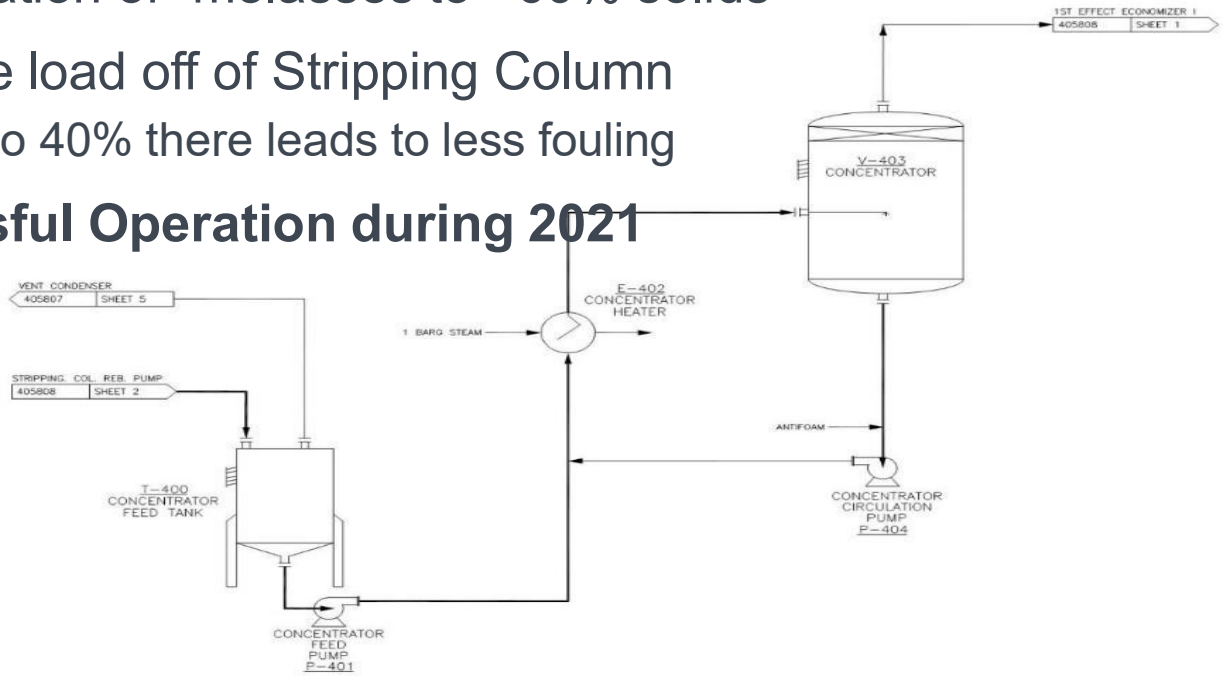
- Horizontal vapor discharge means less molasses entrainment
- Larger valve openings results in less potential for fouling
- Stainless steel tray construction to eliminate corrosion
- Tray valves chosen for maximum turn-up / turn-down capability, typically 30-40% of range
- Valves designed to help move the



Distillation – Molasses Concentrator

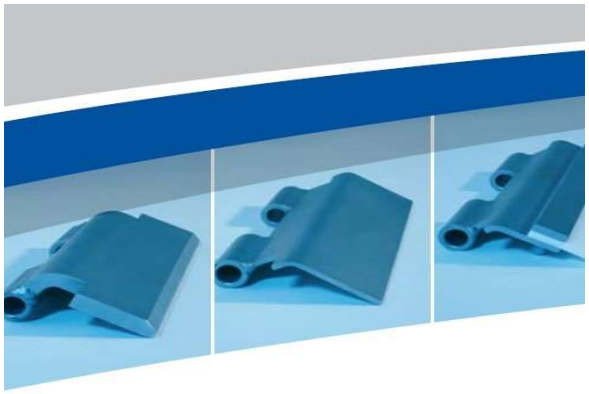
Molasses Concentrator – (Optional Equipment)

- Steam Consumption is minimal (close to 100% of energy is recovered)
- Increases concentration of molasses to ~60% solids
- Can be used to take load off of Stripping Column
  - Only concentrating to 40% there leads to less fouling
- **1st Unit in Successful Operation during 2021**



Distillation – Optional Thin Film Evaporator (TFE)

- Increases molasses concentration to 75% solids (50-60% Standard Plant)
- **Steam Consumption is minimal** (close to 100% of energy is recovered)
- Most effective technology for viscous fluids and fouling services
- Multiple installations worldwide **since 2010 for SPC Applications**.
- Does not require CIP for long periods of time
- No lower bearing – reduces downtime and maintenance requirements
- Lifting of the rotor is not required for mechanical seal repair – saves on downtime



TFE	Short description
POWERFILM	Metal wipers of special geometry and shape

Thank You!

Maximize profits.

Minimize downtime.

www.crowniron.com