KUMAR METAL INDUSTRIES PVT. LTD.
In Joint Venture with
CROWN IRON WORKS, USA.

CRUSHING TECHNOLOGY
FOR EXTRUDED SOYBEAN

Presented By: Rajesh Soni
Project Manager

KUMAR METAL INDUSTRIES PVT. LTD.
<table>
<thead>
<tr>
<th>Corporate Overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Established in the year 1939</td>
</tr>
<tr>
<td>- Corporate Head Quarters located in Mumbai</td>
</tr>
<tr>
<td>- Complete solution provider to the oilseed crushing, solvent extraction oil refining, and Biodiesel industry</td>
</tr>
<tr>
<td>- Our presence across 60 countries and serve over 500 customers</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Our Mission</th>
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<tbody>
<tr>
<td>To provide premium service, equipment and process technology, which in turn produces a quality end product that helps to promote our customer's business.</td>
</tr>
</tbody>
</table>
KMIPL is in technical collaborations with Crown Iron works company USA: a world leader in oil extraction and refining plants.

Joint Venture Operations

Certification & Recognition

- ISO 9001-2015 Certification
  Our Quality Assurance System is certified in compliance with ISO 9001-2015 by Notifying Body TUV NORD

- CE-PED & Machinery Certification
  Kumar Metal Industries is approved to design and manufacture pressure vessels in compliance with the European Council's Pressure Equipment Directive 97/23/EC & Machinery Directive 98/37/EC, by the European Notifying Body

- ATEX
  Testing and certification of all equipment to be used in a potentially explosive atmosphere are approved under the ATEX Directive 94/9/EC, by the European Notifying Body

- Approval for Australia and New Zealand codes
Kumar’s manufacturing & fabrication units span across 22,762 sq. meters, house over 400 skilled technicians, quality control personnel, dedicated workmen & the latest precision European machinery. Our fabrication facilities are capable of manufacturing high pressure vessels & are equipped with certified x-ray qualified welders. For hard facing & critical wear & tear parts our highly trained TIG/MIG welders take over. Crucial to every part of the process, our quality department checks the project at every stage ensuring our clients always get superior quality products. Our equipment has a reputation of being robust in construction, superior in quality, versatile in nature & operationally profitable. Also, our vastly experienced personnel provide training to customers; operating staff.

<table>
<thead>
<tr>
<th>Factory Details</th>
<th>Mira Road Unit No.1</th>
<th>Manor, Palghar Unit No.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land (Sq. Ft)</td>
<td>45,000</td>
<td>2,00,000</td>
</tr>
<tr>
<td>Covered Area (Sq. Ft)</td>
<td>40,000</td>
<td>77,000</td>
</tr>
<tr>
<td>Building (Sq. Ft)</td>
<td>6,000</td>
<td>2,270</td>
</tr>
<tr>
<td>Fabrication Bay (Sq. Ft)</td>
<td>30,000</td>
<td>56,000</td>
</tr>
<tr>
<td>Machine shop (Sq. Ft)</td>
<td>6,500</td>
<td>12,000</td>
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<tr>
<td>Crane capacity</td>
<td>20 ton<em>4 and 5 ton</em>2</td>
<td>30 ton<em>2 and 20 ton</em>5</td>
</tr>
<tr>
<td>Stores (Sq. Ft)</td>
<td>7,000</td>
<td>9,000</td>
</tr>
</tbody>
</table>
Kumar Infrastructure

Kumar Strengths

- Process Design
- Detailed Engineering
- Equipment Manufacturing
- QA/QC Approval
- Erection
- Trial Run & Commissioning
- Performance Optimization
- Operation & Maintenance Training
Kumar Strengths - Engineering Tools

- AutoCad latest version
- CADWorx P&ID
- CADWorx Pipe
- Navisworks
- ChemCAD
- HTRI
- Compress
- Solid Works
- FEA

Kumar Services Offered

- **Technology Identification:**
  Identify the appropriate technology and selection of equipment with modern technology in various processes.

- **Project Execution:**
  Experienced engineers coordinate individual project from start to finish.
  Well qualified mechanical/chemical engineers having vast experience for project execution.

- **Engineering**
  Equipment and Foundation layout P&ID's, utility consumption Parameters, 3D Modeling, structure design, utilities and complete design integration of complex.
  Have designed plants as per European, American, Australian, NZ standards, including FEA analysis, Stress analysis and Structural load designing.
### Kumar Services Offered

**Installation:**
Well trained Installation team in all aspects such as shifting of equipment, foundation layouts, piping, instrumentation, cabling and Insulation. Kumar has installed plants all over the world.

**Commissioning**
Our commissioning team provides dry run and product trials with full performance before handover achieving all utilities and consumption as per our agreement.

**After Sales:**
Our services include trouble shooting, monitor performance, advice on possible expansion plans and improvements.
Kumar believes in 24x7 after sales services.

### Turnkey Solutions

- Installation of the plant including tools and tackles, workshop equipments.
- Pre fab structure for plant buildings.
- Cooling tower, pump with water distribution system.
- Steam boiler with steam distribution network and water treatment plant.
- Air compressor and distribution network.
- Storage tanks design & supply with instrumentation & automation.
- Laboratory equipments & instruments.
- Grain unloading, precleaning & storage Silos.
Kumar Soybean Seed Processing Technology

Mechanical Extraction of Soybean seed
- Full Press (Single Pressing)
- By Extrusion Process
- By cooking Process

Solvent Extraction
- Prepress Cake Solvent Extraction
- Direct Soybean seed Extraction after Preparation

Crushing Technology for Extruded Soybean

Why Extruded Full Fat Soybeans?
- Cost of production is lower than solvent extracted soybean meal
- The oil in extruded full fat soybeans is stable and highly digestible
- Extrusion increases amino acid digestibility.
- Easier and cheaper method to add oil uniformly in the feed
- Frees the oil by rupturing plant cell walls
- Reducing bitter flavors
Dry Extruders Coupled with Expellers for Mechanical Oil Extraction

When coarsely ground soybeans were processed in a dry extruder, the material discharged was in a semi-fluid state when the extrusion temperature was about 140–150 °C. Upon cooling, the oil is absorbed back into the protein matrix and the material becomes a dry and mealy mass. In order to extract the oil, the extrudate must be pressed immediately after extruding. There is progressive loss of oil extraction efficiency upon cooling of the extrudate.

71.8% extraction of oil in a single pass through the extruder and screw press system. The residual oil content in resulting press cake was 6–8%.

The trypsin inhibitor activity in raw soybeans was reduced by 91% due to the heat exposure during the extruding and screw-pressing.

The protein dispersibility index (PDI) was reduced from 88% in the raw material to 13% in the flour. The flour contained 6-8% residual oil and 50% protein on a dry matter basis (0% moisture). The sensory quality of the flour was excellent, with bland flavor and light color.

Objectives of Extruded Soybean

- Soybeans are one of the most nutritious foods that exist today because of the essential nutrients they contain (36% protein and 18% oil as well as all essential amino acids). Even though they are a great source of amino acids, they cannot be consumed raw. The reason for that is because they also consist of anti-nutritional factors such as trypsin inhibitors, urease and lectins that adversely affect digestive efficiency.
- Soybean meal represents more than 50% of the total oilseed meal production. Raw soybeans cannot be used as such for animal feed or human food, because they contain several different antinutritional factors. These factors are:
  a) Trypsin and chymotrypsin inhibitors;
  b) Phytohemagglutinins (Lectins);
  c) Urease;
  d) Allergenic factors; and
  e) Lipases and Lipoxigenases.
- These factors affect the digestion of soybeans in the stomach. All can be deactivated, modified or reduced through proper heat treatment to minimize or eliminate their adverse effect. Since all these inhibitors are proteins, caution should be taken to assure that no destruction of the oilseed protein occurs. This can be accomplished only through optimum processing and good quality control measures.
Extruded Soybean Meal

- It is the meal product resulting from extrusion by friction heat and/or steam of whole soybeans without removing any of the component parts. It must be sold according to its crude protein, fat and fiber content.
- Extruded/expelled soybean meal (ESBM) is produced by mechanical friction creating a high temperature for a short time period. The temperature and the time spent at a given temperature directly affects the quality and nutritional value of the product.
- The extruded oil that is produced has unique characteristics in terms of stability and low levels of phosphatides, unsaponifiable matter, peroxide value and free fatty acids.
## Factors Affecting Soybean Composition
- Plant
- Soil fertilization
- Nitrogen fixation
- Soil trace minerals
- Locality climate & environment
- Water
- Agronomic practices

### Crushing Technology for Extruded Soybean

#### Mechanical Extraction of Extruded Soybean
Typical Specification – Feed Soybean Seed
- Oil Content : 19-20%
- Protein : 36-38%
- Process : FULL PRESS

- FULL PRESS (Single Pressing):
  - Residual Oil in cake : 6-8 %
  - Protein : 42-44%
  - Moisture: 9-10%
## Crushing Technology for Extruded Soybean

### Cooking Temperature

- **Dry Extrusion**: 140 – 160 Deg.C (Friction)
- **Wet Extrusion**: 135 – 140 Deg.C (Steam, less friction)
- **Expander**: 100 – 140 Deg.C (Steam, less friction)
- **Toasting, SEP**: 100 – 105 Deg.C

## Performance of Extruding-Expelling Systems

Extruding-Expelling Soybeans and Cottonseed Oil

<table>
<thead>
<tr>
<th>Oilseed (%)</th>
<th>Oils (%)</th>
<th>Protein in seed (%)</th>
<th>Extraction efficiency (%)</th>
<th>Extruding temperature (ºC)</th>
<th>Oil in meal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonseed</td>
<td>26–30</td>
<td>20–22</td>
<td>20–22</td>
<td>65–70</td>
<td>110–120</td>
</tr>
</tbody>
</table>

All values used for oil content are expressed in average ranges. Actual content varies due to differences in varieties and growing conditions. Operator management also influences the quality of the end product.
I. II. III.

Extruded Soybean Meal

Use of Extruded Soybean Meal

- Soybean meal is commonly used in swine diets worldwide.
- Soybean meal products contain high concentrations of protein, an excellent balance of amino acids and high-energy content, making them an excellent source of protein.
- Soybean meal contains elevated levels of lysine and tryptophan, amino acids that are deficient in common energy sources such as corn.
- Using soybean meal, it is possible to simplify diets and not require other supplemental protein sources.
- Soybean meal is widely used as a protein supplement in livestock diets.
- Dry extruded soybean meal (DESB) is a soybean meal product that has a higher fat content than regular solvent-extracted soybean meal. This product is currently available to swine producers in Manitoba.
Crushing Technology for Extruded Soybean

Extruded Soybean Meal for Animals

I. II. III.

Oil Mill Process Flow Diagram

Crushing Technology for Extruded Soybean

Oil Seeds
Seed Preparation
Pressing
Pressed cake
Sludge/Foots
Crude Oil
Filtered Crude Oil

Oil Seeds
Seed Preparation
Pressing
Pressed cake
Sludge/Foots
Crude Oil
Filtered Crude Oil

Extruded Soybean Meal for Animals

I. II. III.
Crushing Technology for Extruded Soybean

Kumar Expellers

- New Super Press Series
- New Oil N Oil Series
- Xpress Series
- PK Series
**Crushing Technology for Extruded Soybean**

Mid range expellers with double/Triple chambers designed to meet the needs of medium sized mechanical Extraction Plants

![Kumar New Super Press Series](image)

**Crushing Technology for Extruded Soybean**

<table>
<thead>
<tr>
<th>Kumar New Super Press Series</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>TECHNICAL DATA</th>
<th>FULL PRESS</th>
<th>PRE-PRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>NSP IIB</td>
<td>NSP III CLD</td>
</tr>
<tr>
<td>Capacity MT /24h</td>
<td>22-25*</td>
<td>45-55</td>
</tr>
<tr>
<td>Residual oil in cake %</td>
<td>7-10</td>
<td>7-10</td>
</tr>
<tr>
<td>Rated Power for Main motor HP</td>
<td>75</td>
<td>150/175</td>
</tr>
<tr>
<td>Rated Power for Oil N Foots Conveyor HP</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Chamber size Feed mm</td>
<td>Φ279.4 x 939.8 L</td>
<td>Φ330 x 939.8 L</td>
</tr>
<tr>
<td>Chamber size Middle mm</td>
<td>X</td>
<td>Φ279.4 x 584.2 L</td>
</tr>
<tr>
<td>Chamber size Discharge mm</td>
<td>Φ209.5 x 863.6 L</td>
<td>Φ254 x 863.6 L</td>
</tr>
<tr>
<td>Approx.Wt. MT</td>
<td>7.5</td>
<td>10</td>
</tr>
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</table>
Small to Mid range Single chamber expellers designed to meet the needs of small and medium sized mechanical Extraction Plants

<table>
<thead>
<tr>
<th>TECHNICAL DATA</th>
<th>UNIT</th>
<th>FULL PRESS</th>
<th>PRE PRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>NMK IVC</td>
<td>NMK VII</td>
<td>NMK VII</td>
</tr>
<tr>
<td>Capacity (MT/24h)</td>
<td></td>
<td>10-12</td>
<td>25-30</td>
</tr>
<tr>
<td>Residual oil in cake (%)</td>
<td></td>
<td>7-9</td>
<td>7-9</td>
</tr>
<tr>
<td>Rated Power for Main motor (HP)</td>
<td></td>
<td>40</td>
<td>60/75</td>
</tr>
<tr>
<td>Rated Power for Oil N Feet Conveyor (HP)</td>
<td></td>
<td>X</td>
<td>0.5</td>
</tr>
<tr>
<td>Chamber size (Dia. X Length) (mm)</td>
<td></td>
<td>178/222x 1117.6 L</td>
<td>Ф255/230 X 1565 L</td>
</tr>
</tbody>
</table>
Kumar X’Press Series

Largest of all series consisting of Steel cast Double chamber expellers with Horizontal and Vertical feeders
Designed for Press of Palm Kernel

<table>
<thead>
<tr>
<th>TECHNICAL DATA</th>
<th>FULL PRESS</th>
<th>PRE-PRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>XP-200</td>
<td>XP-250</td>
</tr>
<tr>
<td>Capacity, MT /24h</td>
<td>75-130*</td>
<td>90-150*</td>
</tr>
<tr>
<td></td>
<td>100-180*</td>
<td>120-200*</td>
</tr>
<tr>
<td>Residual oil in cake, %</td>
<td>7-10</td>
<td>7-10</td>
</tr>
<tr>
<td></td>
<td>16-20</td>
<td>16-20</td>
</tr>
<tr>
<td>Rated Power for Main motor, HP</td>
<td>215 / 335</td>
<td>250 / 335</td>
</tr>
<tr>
<td></td>
<td>215 / 335</td>
<td>250 / 335</td>
</tr>
<tr>
<td>Rated Power for Oil N Foots Conveyor, HP</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rated Power for Horizontal Feeder, HP</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Rated Power for Vertical Feeder, HP</td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>7.5</td>
</tr>
<tr>
<td>Chamber size, Feed, mm</td>
<td>Φ 300 x 1300 L</td>
<td>Φ315 x 1300 L</td>
</tr>
<tr>
<td></td>
<td>Φ 300 x 1300 L</td>
<td>Φ315 x 1300 L</td>
</tr>
<tr>
<td></td>
<td>Φ 300 x 1300 L</td>
<td>Φ315 x 1300 L</td>
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<tr>
<td></td>
<td>Φ 300 x 1300 L</td>
<td>Φ315 x 1300 L</td>
</tr>
<tr>
<td></td>
<td>Φ 300 x 1300 L</td>
<td>Φ315 x 1300 L</td>
</tr>
<tr>
<td></td>
<td>Φ 300 x 1300 L</td>
<td>Φ315 x 1300 L</td>
</tr>
<tr>
<td>Disch, mm</td>
<td>Φ275 x 1350 L</td>
<td>Φ290 x 1350 L</td>
</tr>
<tr>
<td></td>
<td>Φ275 x 1350 L</td>
<td>Φ290 x 1350 L</td>
</tr>
<tr>
<td></td>
<td>Φ275 x 1350 L</td>
<td>Φ290 x 1350 L</td>
</tr>
<tr>
<td></td>
<td>Φ275 x 1350 L</td>
<td>Φ290 x 1350 L</td>
</tr>
<tr>
<td></td>
<td>Φ275 x 1350 L</td>
<td>Φ290 x 1350 L</td>
</tr>
<tr>
<td></td>
<td>Φ275 x 1350 L</td>
<td>Φ290 x 1350 L</td>
</tr>
<tr>
<td>Approx. Wt., MT</td>
<td>17.5</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>17.5</td>
<td>18</td>
</tr>
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</table>
Kumar Expellers – PK Series

Specially designed and manufactured for extraction of Palm Kernel consisting of Fabricated single chamber expellers

<table>
<thead>
<tr>
<th>TECHNICAL DATA</th>
<th>UNIT</th>
<th>FIRST PRESS</th>
<th>SECOND PRESS</th>
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<tbody>
<tr>
<td>Type</td>
<td>PK-15</td>
<td>PK-25</td>
<td>PK-15</td>
</tr>
<tr>
<td>Chamber size (Dia X Length) mm</td>
<td>Ф178 x 640</td>
<td>Ф209 x 640</td>
<td>Ф178 x 640</td>
</tr>
<tr>
<td>Capacity MT/24 h</td>
<td>12/15</td>
<td>22/25</td>
<td>8/10</td>
</tr>
<tr>
<td>Residual oil in cake %</td>
<td>18-20</td>
<td>18-20</td>
<td>8-10</td>
</tr>
<tr>
<td>Required power rating Kw/HP</td>
<td>37/50</td>
<td>55/75</td>
<td>37/50</td>
</tr>
<tr>
<td>Approx. Wt. MT</td>
<td>4.5</td>
<td>4.8</td>
<td>4.5</td>
</tr>
</tbody>
</table>
Salient Features - Kumar Expellers

- High efficiency External Gear Box.
- Sturdy Construction, low Investment and easy installation.
- Maximum Oil yield at low operating costs.
- Suitable to crush all type of edible and non-edible oil seeds.
- Easy and time saving main worm shaft removal without disturbing the gear box assembly.
- Vertical split hinged main cages provided with cage lifting for safe, quick and effortless maintenance.
- Maximum oil yield at low operating cost due to our chamber, cage bars and shims design.
- Convenient height of worm shaft for easy maintenance.
- Easy worm shaft withdrawal without disturbing the expeller drive.
- Hydraulic Chamber opening and closing reduce the manual effort and save time of the operator during maintenance.

Crushing Technology for Extruded Soybean

Salient Features – Kumar Expellers

- We use special electrodes for hard facing which makes the life go on 3-4 times the normal electrode. This is a major recurring cost which goes down making it a faster return on investment.
- Hydraulic cone adjustment system - adjustment can be done while the expeller is in running condition, cake thickness is adjusted by control valves. It saves time as in manual operation you have to stop the expeller various time to adjust cone.
- Special designed locking type clamping bars and bolts to enable easy tightening & removal of the cage.
- Fully enclosed cage with a built in screw conveyor at the base for conveying oil and foots which keeps the shop floor neat and clean.
- Steel cast hobbing cut helical gears. Induction hardened, completely assembled on a single piece hollow driving sleeve with heavy duty roller and taper roller bearing to acquire perfect alignment and friction free for energy saving.
- Multistage vertical stack cooker for proper conditioning of the seeds.
- All the bearings are SKF/ZKL and are lubricated with the help of a special motorized pump to increase bearing life.
Crushing Technology for Extruded Soybean

- **Magnetic Separator**
  The Rotary Magnetic Drum Separator provides automatic separation of ferrous and non-ferrous material.

- **Seed Cleaner**
  Seeds are properly cleaned into seed cleaner to remove unwanted material like dust, leaves, stones, etc. Then the seeds are subjected to Destoner to remove various sizes of stones / sand. This removal of unwanted material reduces the down time & increases the life of machines.

Kumar Equipments used in Extruded Soybean process
Online Weighing
Online Weighing machine is used to measure the feed seed quantity in the plant by the help of load cells.

De-stoner
Vibratory type operating on vacuum principle. Steel box frame with sieve slope adjustment. Sieve box supported on rubber blocks with durable wooden sieve frames, covered with steel screens, aluminium baffles and cleaners. Complete with inspection windows and adjustable stone separation device. Includes cyclone, air lock and air fan.

Crushing Technology for Extruded Soybean

Kumar Equipments used in Extruded Soybean process

Hammer Mill
Hammer Mill is mainly used to disintegrate the seed to desired size to have the proper Expelling. The Hammers (Beaters) are rectangular for efficient grinding & are made from hardened alloy steel.

Extruder
Extrude is used for conditioning of seed by friction to increase the outlet temperature of cracked seed by 140-150 deg. c to reduce urease activity.

Kumar Equipments used in Extruded Soybean process
Cake Cooler
Modular horizontal type single/Double pass chain conveyor type, enclosed unit fitted with blowers, radiators and gear box motors. Drive module fitted with main conveyor sprockets, shafts, pedestal bearing drive gear box, drive chain and sprocket rotary feed unit. Drying module contains steam radiator, FD Blower, ID fan blower. Cooling module contains blower, ID fan, Discharge module fitted with main conveyor sprockets shaft take up type pedestal bearing, discharge hopper, fins collecting screw and complete with drive unit.

Weighing, Bagging & Stitching Machine with Slat Conveyor
• Consisting of Feed hopper, pneumatically operated load cell type bagging, weighing system and discharge hopper for weighed materials, slat conveyor, stitching machine and pneumatically controlled system.
• Feed hopper & discharge hopper is made up of Mild steel plate
• Stitching machine is used for stitching the bags.
• Each bagging machine will be suitable 50 - 60 Kg bag each with accuracy of +/-100 Grams or better on average of 20 consecutive weighing.
Filter Press
Filter press is used to separate the fine sludge from the feed oil by using Filter cloth.
Plate type CI filter press complete with ratchet tightening arrangement, filter cloth set, cocks, pressure gauge and safety valve and pump with motor.

Vibro-Separator
The Vibro Separator is a separating machine of coarse sludge from crude oil, which includes a vertical type special motor to facilitate three dimensional composed circular and elliptic motions in horizontal, vertical & inclinational faces. The vibro separator achieves superior performance as the feed (Crude Oil) is dispersed from the centre equally; hence all parts of screen cloth are fully utilized.

KUMAR SOLVENT EXTRACTION PLANTS FOR
Prepress / Full-press Cake like Palm Kernel, Shea, Sunflower, Groundnut, Cottonseed, Rape seed, Copra, Castor Seed, Niger,
Solvent Extraction Plants With Preparatory for Various Feeds like Soybean, Cottonseed, Rice Bran, Salnut, Pk, etc.
Specialty Solvent Extraction Plant For Essential Oils, Pine chips, polymers
General Steps
- Preparatory
- Solvent Extraction - Extraction
  - De-solventisation
  - Distillation
  - Recuperation
- Meal Cooling & DOC Bagging

Typical Kumar Extractor

- Specially designed perforated SS wire mesh & cadre frame provided below the bed for proper solvent drainage and to reduce chocking there by improving extraction efficiency
- Extractor with single piece miscella hopper having no weld joints
- Extractor is delivered after successful no load trial runs at shops
• DT is specially designed with uniform counter flow system of steam distribution in the trays during de solventization – toasting & vapor separation.
• Specially designed sparge steam tray to facilitate better de solventization and uniform moisture addition for better toasting of meal
Kumar Refining Process of Crude Oils

Crude Oil contents

- Phosphatides
- Wax
- Free Fatty Acid
- Moisture
- Odoriferous Material
- Pigments
**Kumar Refining Process of Crude Oils**

**Key Process:**
- Water Degumming & Neutralisation
- Pre-treatment & Bleaching
- De-acidification / Deodorizing

**Kumar Refining Process of Crude Palm Oil / Palm Kernel Oil**

**Additional Process:**
- Dry Fractionation
- Multiple Fractionation
Kumar Refining Process

- Refinery involves
- Degumming or acid conditioning to remove phosphate
- Neutralization or DE acidification to remove free fatty acids by treatment with lye (called alkali neutralization or chemical refining) or by distillation (called Physical refining)
- Bleaching to remove pigment by adsorption treatment
- Deodorizing and stripping in vacuum condition to remove odors
- DE-waxing, hydrogenation, fractionation.

Kumar Water Degumming & Neutralisation Section

Crude oil as received from extraction plant contain some non-triglyceride component which must be removed eg. Phosphatides, free fatty acids, pigment odor and flavors waxes as well as heavy metal, pesticides etc.

The Edible Oil Refining process depending on types of Phosphatides either water degumming, Acid Degumming, or Super degumming is carried out so as to yield Phosphorous contents of less than 10ppm.

Degumming is the first stage in refining process. It is used to separate gums, phospholipids, protein etc that are insoluble in oil when hydrated

**Aim of degumming**

The emulsification action of phospholipids increases oil losses during alkali refining

Gums lead brown discoloration of oil after heating during deodorization.

Salts may be formed with copper magnesium calcium and iron accelerating oxidative degradation of oil

Certain phosphatides such as lecithin, find widespread industrial application
Kumar Water Degumming & Neutralisation Section

PURPOSE:

To remove the contaminants from crude oil prior to Deodorization
- Insoluble solids (Meal)
- Phospholipids (Gums)
- Oxidative materials (Metal Ions)
- Metals & pr-oxidants (Cu, Ca, Fe, Mg and P)
- Color bodies (Chlorophyll & Carotenes)

Kumar Pre-treatment & Bleaching Section
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Operating Conditions Bleaching Section

<table>
<thead>
<tr>
<th>Condition</th>
<th>Range</th>
<th>Typical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>Up to 125°C/260°F</td>
<td>85-110°C 185-230°F</td>
</tr>
<tr>
<td>Time</td>
<td>30-40 min</td>
<td>30-40 min</td>
</tr>
<tr>
<td>Vacuum</td>
<td>50-70 mmHg</td>
<td>50-70 mmHg</td>
</tr>
<tr>
<td>Moisture</td>
<td>0.1-0.5%</td>
<td>0.2-0.3%</td>
</tr>
</tbody>
</table>
The bleacher vessel is a vacuum vessel with dished heads, multiple agitated compartments, agitator with mechanical seal, sight glasses, and manways. It operates under vacuum to ensure complete moisture/air removal. The dry oil and earth mixture is discharged by the filter charge pumps to one of the bleaching filters.

**Bleacher Vessel**

Salient Features

- **Compact Design** - A Single vessel for bleaching earth slurry preparation & Bleaching
- Better contact between oil & bleaching earth since bleacher is equipped with mechanical agitation & sparging steam
- Maximum Oil recovery by steam blowing results in lower retention of oil in spent earth
- Low consumption of bleaching earth
- Lower consumption of utilities
- Ensure accurate dosage of bleaching earth controlled by PLC
- No carryover of bleaching earth to the vacuum system
- Efficient Automated filter operation

**Kumar Pre-treatment & Bleaching**
Pressure Leaf Filters

Recent Trends in Bleaching

- Kumar Steam Agitated Bleacher
- Improved bleaching clay activity while maintaining fast filtration
- Inline color and turbidity measurement
- Pulse tube filter replacing bag filters as the polish filter (most useful for stock changes)
### Kumar De-acidification / Deodorizing:

**PURPOSE**

Improve odor, flavor, colour and stability of oils and fats by removing or inactivating:

- Material causing unpleasant odors or flavors (FFA, aldehydes & ketones)
- Unsaponifiables (tocopherol and sterols)
- Oxidative materials (peroxides)
- Colour bodies (carotenoids)
- Toxic substances (pesticides & herbicides)

### Types of Deodorizers

- Continuous Deodorization
- Tray Type
- Packed Column (PC)
Typical Deodorizing Feedstock Specifications

- Free Fatty Acid (FFA): 0.07% - 5%
  - 0.07% to 0.1% for neutralized oils and fats
  - 3% to 5% for palm oil and edible fats
- Phosphatides: 2-10 ppm P
- Moisture: ≤ 0.1%
- Iron (Fe): ≤ 0.2 ppm
- Unsaponifiables: 1.0%
- Soap: zero
- Impurities: zero

Kumar Continuous Deodorizing System

Benefits:
- Designed for:
  - Deacidification (physical refining)
  - Deodorizing
- Low Trans
- Preserve oil quality
- Maximum protection from air
- Low steam consumption
- Low energy consumption

Flexibility

Quality

Yield

Economy
Kumar Deodorizer

- No stagnant zone.
- Ensures large surface area provided by structured packing to stripped of the FFA (free fatty acid)
- Ensures an extremely high steam to oil interfacial surface.
- Highly efficient mammoth pump for sparging the steam to ensure the intensive agitation.
- Low pressure drops.
- Robust construction.
- Easy maintenance.
- Low stripping steam required.
- Optimized retention time reduces low trans fatty acid formations.
- Minimum carry over of the fatty acid by specially designed fatty acid scrubber equipped with structured packing & demister pad.
- Heating & cooling under vacuum
- Specially designed automation system for risk free & easy operation to avoid human error.

Kumar Deodorizer

Automation System for Deodorization Section

Kumar metal provides dedicated PLC based plant control automation system. Allow the plant operator to monitor all the process activity like plant start up, shut down & process parameters from one centralized location.

Easy system helps the operator to understand how to proceed with the operation sequence by easy graphical presentation.

Risk free operation with minimum human mistakes.

Data locking of all the process parameters.

History data base to analyze for all process parameters and generated the report which is undeniable witness of complete activity of process.
Salient Features

Well designed structured packing in the Deaerator, Low steam requirements - Optimised live steam injection and full vacuum to ensure excellent deaeration of oil. Minimised polymerization in heat exchangers. High heat recovery in Deodorizer having efficient Inbuilt Economizer - Maximum heat is recovered from deodorized oil to ensure proper oil temperature for storage for optimum shelf life. Efficient deodorizing of oil, Low cross-contamination - Kumar system is designed for optimum deodorization temperature and high retention time to ensure enhanced shelf life of refined oil having negligible Trans Fatty Acids. Low oil carryover with fatty acid resulting in lower deodorizing process loss. Efficient designed vacuum system for low motive steam consumption. Well designed liquid distributor in vapor scrubber to ensure optimum condensation of free fatty acid vapours.
Kumar Crown Semi-Continuous Deodorizing System

Salient Features

- Designed for:
  - Multiple products, frequent stock changes
  - Deacidification (physical refining)
  - Deodorizing
  - Low comingling
  - High deodorizing efficiency
  - Preserve oil quality
  - Low steam consumption
  - Low energy consumption

Recent Trends in Deodorizing

- Two stage (dual) scrubbers for concentrating tocopherol distillate for soya oil
- Concentrating Palm Fatty Acid Distillate (PFAD) FFA to 93%. The increase in FFA of PFAD will increase the yield of RBD Palm Oil. However it is Feasible for 400TPD capacity and above due to increase in capex cost.
- Increased use of chilled loop and ice condensing vacuum systems
- Semi continuous di flow deodorizing for multiple stock changeovers
Vacuum System Considerations

1. 4 stage direct contact (barometric) with dirty cooling tower
2. 4 stage direct contact with closed loop
3. 4 stage indirect contact (surface condenser)
4. 3 or 4 stage direct contact with chilled loop
5. 4 stage direct or indirect contact with ice condensing

Vacuum System Cost Comparison

<table>
<thead>
<tr>
<th>Cost</th>
<th>Surface Condenser</th>
<th>Closed Loop</th>
<th>Chilled Loop</th>
<th>Ice Condensing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment</td>
<td>1</td>
<td>1.1</td>
<td>1.25</td>
<td>3</td>
</tr>
<tr>
<td>Electrical</td>
<td>1</td>
<td>4</td>
<td>22</td>
<td>16</td>
</tr>
<tr>
<td>Cooling Water</td>
<td>1</td>
<td>0.9</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>Total Operating</td>
<td>1</td>
<td>0.9</td>
<td>0.5</td>
<td>0.2</td>
</tr>
</tbody>
</table>
Kumar Dry Fractionation Technology

A process to separate vegetable oils such as palm oil into two fractions, Olein and Stearin, by the crystallization properties of the oils.

**Crystallization Section**
Preheating RBD palm oil
Cooling in a controlled environment to form crystals using PLC or programmable controllers.

**Filtration Section**
An automated membrane filter press to separate the stearin crystals from the liquid olein. Olein yield is maximized by squeezing the stearin cake through inflation of the membrane with air or liquid.
Separating high-melting fractions (stearin) from low-melting fractions (olein) by cooling in a controlled process is called fractionation. One of the key factors determining the success of the fractionation process is the efficiency of separation. Fractionation is designed to separate various fractions based on differences in crystallizing temperatures.

Kumar Dry Fractionation Technology

Kumar Plant & Process Automation Services

Automation is the use of control systems and information technologies for plant operation by reducing human intervention.

General plant operation modes:
- Manual
- Semi automatic
- Automatic

Benefits:
- Increased labor productivity and reduction in labor cost
- Mitigates the effects of labor shortages
- Reduction/Elimination of routine manual/clerical tasks
- Improved Human and Plant safety
- Better Process Control and Improves product quality
- Reduction in manufacturing lead time
Kumar Plant & Process Automation Services

KUMAR Automation is with the state of the art instrumentation and Software for complete processing control from the Desk.

It can offer Off Site control trouble shooting through our Cloud based online system. The refinery can be operated from a remote control through internet and also rectification of the process can be carried out from the remote location.

Process automation ensures better control of critical process parameters like steam, water and all other utilities and chemicals thus improving final oil quality and reducing human error. Through our automation you can control critical operation like the switching over of the pressure leaf filters as well, maintaining and sealing Vacuum in the deodorizer and also getting complete accountability of raw material coming into the plant and finished product going out, through our totalizer and mass flow meters.
Kumar Deodorizer

Highlights of Kumar Plants

Optimum energy and utility consumption per MT of feed

Solvent Extraction Plants are designed confirming NFPA 36

Well designed and manufactured equipment as per applicable design code like ASME section VIII Div. 1 with high level of quality

All heat exchangers, coolers, condensers as per ASME section VIII Div. 1, TEMA & Sound Engineering Practice (SEP) standards & Third party Inspections

Electrical motors, cable, control panels are confirming to IEC standards

Kumar systems are in accordance to Health and safety requirements as per international norms
### Highlights of Kumar Plants

- Project bought outs (like Motors, Gear Box, Pumps, Vacuum systems, Instruments, etc.) from reputed multinational companies like Siemens, E+H, KSB, Mazda (Croll Reynolds), Buhler, etc.

- Technical construction file of equipment comprising of QAP, Material Test Certificates, stage wise Inspection report, Final test reports, etc. is provided along with equipment supply.

- Turnkey Projects are executed by competent & experienced project team with proper monitoring of quality & schedule.

- Pre-Commissioning & product trials are carried out by experienced commissioning engineers to ensure proper operation to achieve desired product quality & rated capacity.

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**THANK YOU**

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