

TECH-KNOWLEDGE

The Official PMG Engineering Newsletter

FOOD & BEVERAGE
INDUSTRY

ENGINEERING
& DESIGN

SCIENCE &
TECHNOLOGY

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Lactic Acid Fermentation



Introduction

Lactic acid bacteria perform an essential role in the preservation and production of many varieties of foods. It has got various applications in food, pharma, and allied industries due to its peculiar flavour and aroma. It is also inexpensive, and needs little or no heat in the application, making them fuel-efficient as well.

The production of lactic acid from hexoses (6 Carbon sugar) is a peculiar metabolic activity, also named 'fermentation', of LAB (Lactic Acid Bacteria) such as *Lactococcus*, *Lactobacillus*, *Enterococcus*, and *Streptococcus* spp. For these reasons, fermentative bacteria are commonly employed in the food industry as starter cultures for the industrial processing of fermented dairy, meat, cereal, and vegetable products.

On the other hand, lactic acid can be also used as a food additive in the industry of edible products without the presence of LAB fermentation. This option can be extremely useful in various ambits. Both the homofermentative and the heterofermentative lactic acid bacteria are generally fastidious on artificial media but they grow readily in most food substrates and lower the pH rapidly to a point where other competing organisms can not survive.

Biopreservation of Foods using Lactic Acid Fermentation

Biopreservation refers to extended storage life and enhanced safety of foods using their natural or controlled microflora and (or) their antibacterial products. It may consist of:

- Adding bacterial strains that grow rapidly and (or) produce antagonistic substances.
- Adding purified antagonistic substances
- Adding the fermentation liquor or concentrate from an antagonistic organism
- Adding mesophilic LAB as a 'fail-safe' protection against temperature abuse.

Industrial Production of Lactic Acid

Lactic acid also has a prime position due to its versatile industrial applications in food, pharmaceutical, textile, leather, and other chemical industries. Lactic acid is widely used in food-related applications but recently it has gained many other industrial applications like biodegradable plastic production.

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Food and food-related applications account for approximately 85% of the demand for lactic acid, whereas non-food industrial applications account for only 15% of the demand.

Lactic Acid Fermentation Process

Lactic acid can be produced by the fermentation of sugars or sugar-containing hydrolyzates or the single-step conversion of starchy or cellulosic wastes by direct conversion using amylolytic lactic acid-producing microorganisms or by the simultaneous hydrolysis and fermentation with concomitant addition of saccharifying enzymes and inoculum together. There are different processes for the biotechnological production of lactic acid. Generally, hydrolyzate is used instead of refined sugars which can be utilized for submerged fermentation or solid-state fermentation.

Future of Lactic Acid Fermentation

Biodegradable plastic i.e., polylactic acid, can replace synthetic polymers to avoid environmental pollution. So lactic acid production must be economic and environmental friendly with the utilization of renewable biomass. The production of lactic acid from fossil fuels is now widely accepted as unsustainable due to depleting resources and the accumulation of environmentally hazardous chemicals. Even though fermentation can replace the chemical synthesis, the cost of production must reduce for the bulk production of lactic acid for the biodegradable plastic.



Conclusion

The simultaneous saccharification and fermentation of lignocellulosic and starchy materials have its advantages over separate hydrolysis and fermentation. Consumable sugars like glucose released by cellulase or amylolytic enzyme are simultaneously converted to the end product by the microorganism. Glucose inhibition on the enzyme is therefore minimized. Many of the lactic acid bacteria are mesophilic and fermentation can carry out at the optimum temperature of their growth. Simultaneous saccharification and fermentation offer the controlled release of sugar at the optimum growth temperature. The operating temperature of the simultaneous saccharification and fermentation can thus be brought to the level close to the optimum of the cellulase enzyme by using thermotolerant organisms for the efficiency of the whole process.

Insight on Evaporators Used in Food Industry



Introduction

We use jam, condensed milk, milk powder, dried cheese powder in day-to-day life, but have you ever wondered how these things are processed? The food industry is booming and ready to eat meal is one of the reasons behind this. Evaporation is one of the important processing which is used by the food industries for the preparation of food products. In the food industry, raw materials are used which contains more water than required in the final product. The easiest way to remove water/concentrate the food product is to use evaporators.

An evaporator is defined as a heat exchanger intended to heat a given product and separate water by evaporation. Evaporators are widely used in the food manufacturing industry to remove the portion of water from food products. This helps in increasing the total solid content in food products and reduction in the bulk weight which ultimately helps in the facilitation of the transport.

The process of evaporation is different from drying and dehydration as the liquid obtained from it is still in a form of non-solid liquid. Evaporation only serves as the first step in making the finished product into concentrated liquid and dried goods. Powdered ingredients like dairy whitener, whey powder etc. are prepared by spray drying. Hence, we can say that powdered products are a combination of both techniques.

Working Principle

Evaporation is a process in which simultaneous heat and mass transfer process occur resulting in the separation of vapour from a solution. Evaporation occurs where molecules obtain enough energy to escape as vapour from a solution. The rate of escape of the surface molecules depends primarily upon the temperature of the liquid, the temperature of the surroundings, the pressure above the liquid, surface area and rate of heat propagation to the product.

Reason for Installation of Evaporators

- To reduce costs for storage and transportation.
- To induce crystallization.
- It may be used as an economical preparatory step for subsequent dehydration as in the cases of spray drying, vacuum drying, freeze-dried, crystallization and mixing.
- To reduce water activity to increase microbiological and chemical stability.
- Recover valuable substances and by-products from waste streams.

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Components of Evaporator System

1.A heat source: It is generally comprised of a heat exchanger for the evaporation of water.

2.An evaporation vessel: It drives out water from the product as vapour.

3.A vapour separation vessel: It separates vapour and product.

4.A vacuum system: It draws water vapour out of the separation vessel. This vacuum also reduces pressure in the evaporation vessel, which reduces the boiling point.

Types of Evaporators Used

1. Circulation or Vertical Tube Evaporators

Tubes carrying the steam internally are placed vertically in the bottom of the cylindrical evaporator, chamber. It is popularly known as Calandria evaporator.

2. Horizontal Tube Evaporators

In certain conditions, if, for, example, there is limited vertical space for installation, the tubular heat exchanger can be used as a horizontal evaporator. To ensure that both the top and the bottom tubes are covered with liquid, the evaporator must be operated in a flooded condition, i.e., the feed inlet must be positioned above the uppermost tube.

3. Plate Evaporators

The plate evaporator is characterized by a large heat exchange surface occupying a relatively small space. Like the plate heat exchanger, it is constructed from profiled plates with the condensing steam used as a heating medium and the evaporating product passing between alternate pairs.



4. Forced Circulation Evaporators

When highly viscous products are to be evaporated, the forces which normally move the liquid along are not sufficient to transport the product satisfactorily.

5. Falling Film Evaporators:

The heat exchange surface in a falling film evaporator consists of a bundle of tubes down which the product flows. Depending on the design, the tubes are 4-10 m long and have a diameter of 25-80 mm.

Maintenance Tips to Improve Energy Efficiency

1.Prevent air leaks into the evaporators to minimize venting rates. Air is a non-condensable gas and must be vented to keep evaporation vessel pressure from increasing.

2.Clean heat transfer surfaces to allow the most efficient use of energy to evaporate water from the product.

3.Inspect and repair or replace wet or damaged insulation as it is found. Also, make sure insulation is the appropriate thickness.

4.Keep the vapour separation vessel clean to maintain product yields and pressure profiles.

A wide-angle photograph of a lush green pulse field under a bright blue sky with scattered white clouds. The rows of plants are neatly spaced and stretch towards the horizon.

INDUSTRY BUZZ

Price increases for pulses: Moong Dal gets Rs 10, and Tur Dal rises by Rs 15.

Over the past two weeks, pulse prices have surged. In the wholesale market, Tur Dal has seen a steep increase of Rs 15 per kilogram, while Moong Dal has also risen by Rs 10. Notably, the government is actively involved, urging small traders to report their stock.

Before, stock declarations were requested from wholesalers, warehouse operators, and mill owners. However, as of late, small merchants, retailers, and supermarket chain store owners have required stock declarations.

In November, the fresh crop of Tur Dal is introduced to the market. Most of its production occurs in the Vidarbha regions in Maharashtra, including Latur, Akola, Yavatmal, Jalna, and Marathwada.

Dealers report that the country's pulse crop this year has increased by 7% over the previous one.

Bayer collaborates with Gram Unnati and the Government of India Common Service Center.

A global company with core competencies in the life sciences of agriculture and healthcare, Bayer announced its collaboration with Gram Unnati and the Common Service Center (CSC-SPV) of the Ministry of Electronics and Information Technology (MeitY), a key component of the National e-Governance plan that seeks to empower rural India with digital technology and promote a knowledge-based economy.

The strategic partnership seeks to improve rural livelihoods and farm incomes by strengthening digital skills building and giving Indian farmers access to high-quality agri-inputs. The cooperation will help farmers in Uttar Pradesh, Haryana, Rajasthan, Odisha, Madhya Pradesh, and other states during the initial implementation phase. The farmers can take advantage of market access through Gram Unnati and crop-specific agronomic advice through CSC's online platform and access to the full spectrum of Bayer's agri-solutions from seed to harvest.





By 2027, Expocacer wants to see a 92% increase in the production of regenerative coffee.

The "Impact Initiatives 2023" report is being released by the Cerrado Coffee Growers' Cooperative (Expocacer), emphasising socio-environmental projects and future objectives. The bar is anticipated to be raised in the upcoming years, with 25,000 hectares of regenerative coffee being reached by 2027—a 92% increase from the current amount of about 13,000 hectares.

According to the study, the cooperative achieved a significant milestone by producing 143,346.71 kWh of photovoltaic solar energy, sufficient to meet the whole energy needs of the administrative building and a portion of other sectors. The energy produced by the solar panels is the same as planting 106 trees, preventing the release of 77.45 tons of CO₂ and eliminating the need for 65.22 tons of charcoal. This clean, renewable energy source emits no emissions.

PepsiCo releases its first-quarter 2024 financial figures and confirms its 2024 forecast.

PepsiCo, Inc. released the first quarter of 2024 results. "Our businesses performed well and stayed flexible during the first quarter, with our foreign business putting up a solid showing. Despite the impact of several product recalls at Quaker Foods North America and a challenging net revenue growth comparison from the previous year, we delivered a sequential improvement in our volume trends and year-over-year growth in our net revenue, operating profit margin, and EPS, according to chairman and CEO Ramon Laguarta.

Laguarta said, "Going forward, we'll keep concentrating our efforts on performing well in the market and providing delicious products that give consumers convenience and good value." To finance ongoing investments in our brands, capabilities, and pep+ projects, we will keep improving our efficiency measures. Because of this, we still project at least a 4% increase in organic revenue and 8% growth in core constant currency EPS by 2024.



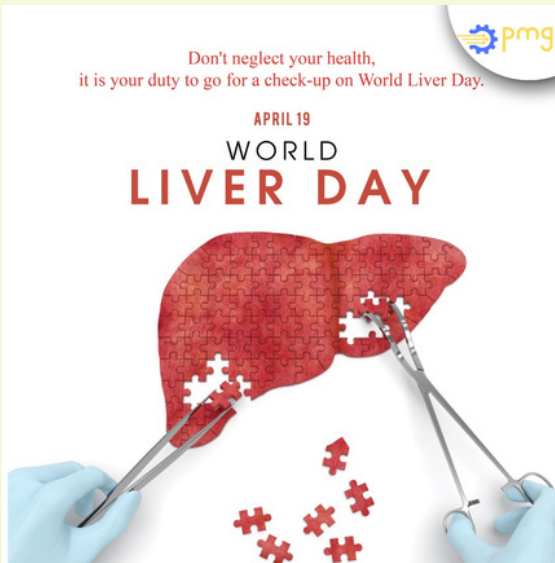
Innovative agriculture initiative launched by IRRI and Dvara E-Registry

Together, the International Rice Research Institute and Dvara E-Registry are launching a major project to improve the lives of women farmers in Odisha. This partnership aims to support the establishment of a Women-led Farmer Producer Company (FPC) in Ganjam district, focusing on increasing agricultural productivity and resilience. It is part of the Climate Smart Rice-based Systems for Prosperity and Resilience (ClimatePRO) project, supported by DA&FE, GOthe I, and OIIPCRA.

This project aims to provide smallholder farmers, especially women, with high-yielding, climate-resilient varieties of valuable crops such as oilseeds, rice, and pulses. In addition, using climate-smart farming techniques seeks to increase farmers' adaptability to climate change, guaranteeing sustainable farming systems across Odisha. One of the initiative's main characteristics is its emphasis on using digital solutions to accomplish its goals.

WEEKS HIGHLIGHT

NON-TECHNICAL CONTENT



19 APRIL

LIVER DAY

World Liver Day highlights the importance of liver health and raises awareness about liver diseases. Being the body's second-largest organ after the brain, the liver's role in digestion and detoxification is paramount.



20 APRIL

MAHAVIR JAYANTI

Mahavir Jayanti celebrates the birth of Lord Mahavir, the 24th Tirthankara of Jainism. It honors his teachings of non-violence, truthfulness, and compassion, inspiring followers towards spiritual enlightenment and ethical living.

APRIL



22 APRIL

EARTH DAY

A global reminder to cherish, protect, and restore our planet. Let's unite to honor the Earth's beauty, biodiversity, and resilience. Together, we can take action to combat climate change, preserve ecosystems, and create a sustainable future for all living beings.

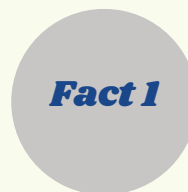
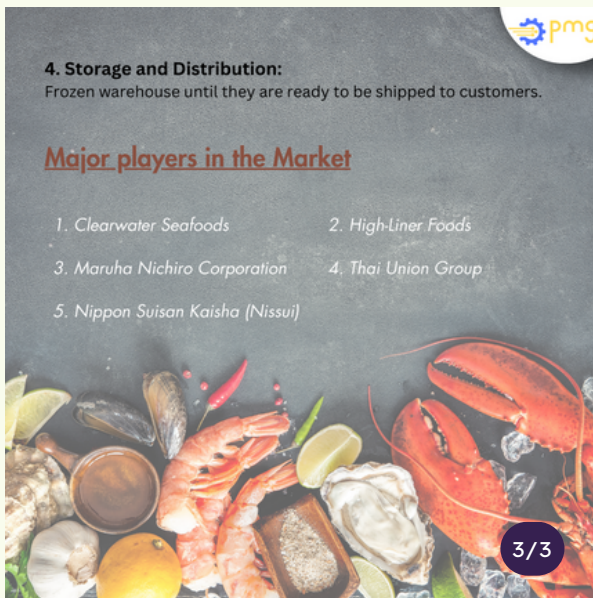


23 APRIL

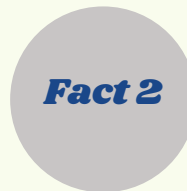
HANU,AM JAYANTI

Hanuman Jayanti celebrates Hanuman's devotion and strength. A symbol of courage, he's honored across India, marking the birth of this revered deity with prayers and festivities.

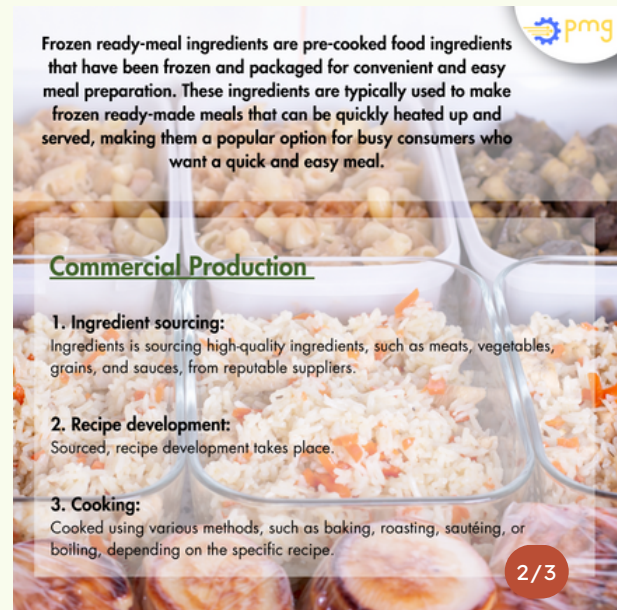
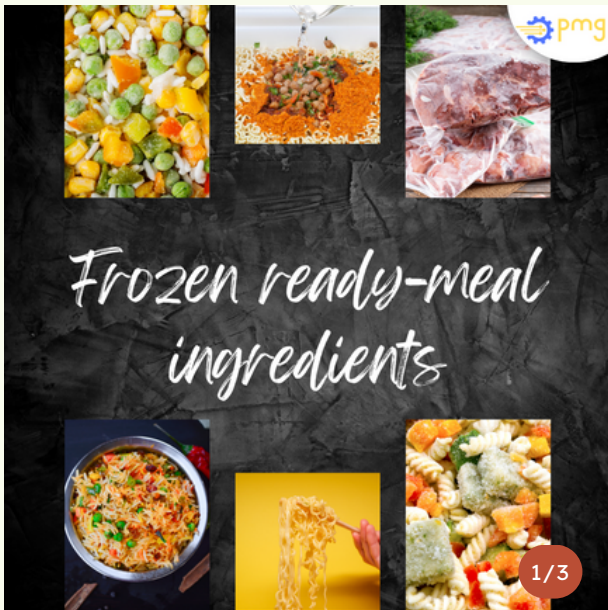
DID YOU KNOW?



Frozen shellfish and crustaceans encompass a variety of seafood delicacies, including shrimp, lobster, crab, and mussels, which have been harvested from the ocean and flash-frozen to preserve their freshness. These frozen products offer convenience and versatility in cooking, allowing consumers to enjoy the flavors and nutritional benefits of seafood without the need for immediate consumption or lengthy preparation.



Frozen seafood preservation demands meticulous handling and advanced techniques. Post-harvest, seafood undergoes thorough cleaning, precise filleting, and inspection. Rapid freezing, typically below -18°C , halts microbial proliferation and enzymatic deterioration, preserving freshness. Vacuum sealing in impermeable packaging prevents moisture loss and oxidative damage.



Frozen ready-meal ingredients are pre-cooked food ingredients that have been frozen and packaged for convenient and easy meal preparation. These ingredients are typically used to make frozen ready-made meals that can be quickly heated up and served, making them a popular option for busy consumers who want a quick and easy meal.

Commercial Production

1. Ingredient sourcing:

Ingredients is sourcing high-quality ingredients, such as meats, vegetables, grains, and sauces, from reputable suppliers.

2. Recipe development:

Sourced, recipe development takes place.

3. Cooking:

Cooked using various methods, such as baking, roasting, sautéing, or boiling, depending on the specific recipe.



4. Freezing:

Frozen to preserve their quality and freshness.

5. Packaging:

Packaged into individual portions or combined with other ingredients to create complete meals.

6. Quality control:

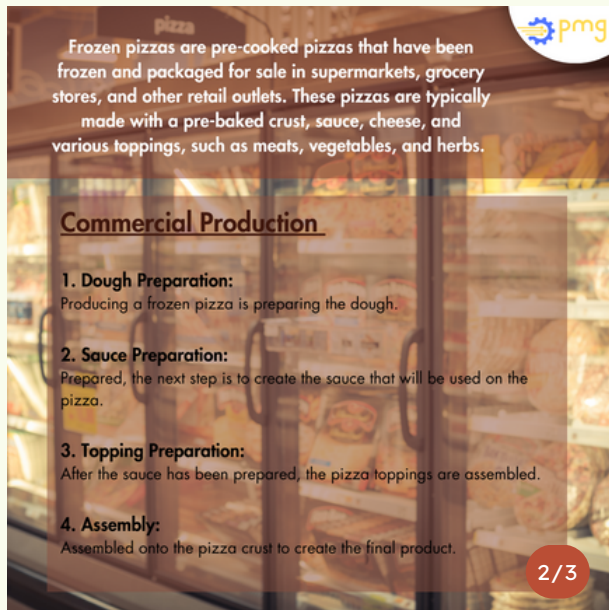
Quality control measures are taken to ensure that the ingredients are cooked properly, frozen correctly, and packaged in a way that preserves their quality and safety.

Major players in the Market

1. Nestle
2. Conagra Brands
3. McCain Foods
4. Unilever

Fact 3

Frozen ready-meal ingredients are pre-prepared food components that have been individually frozen for convenience. These ingredients include proteins like chicken, beef, or tofu, along with vegetables, grains, and sauces. Each component is flash-frozen to preserve freshness and flavor, allowing for quick and easy assembly of complete meals.



Fact 4

Conveniently delicious, frozen pizzas offer a quick and satisfying meal solution for busy days or impromptu gatherings. With a variety of toppings and crust options, they cater to diverse tastes and dietary preferences. Whether it's classic pepperoni, gourmet veggie, or gluten-free options, frozen pizzas provide an easy way to enjoy a hot, homemade-style pizza without the hassle of preparation or delivery.

CRYSTALLIZERS



1/4

Crystallizers are industrial equipment used in various chemical processes to facilitate the formation of crystals from a solution. In the context of sugar processing and refining plants, crystallizers are used to produce refined sugar from raw sugar cane or sugar beet juice.

- The process of sugar crystallization involves the formation of solid sugar crystals from a supersaturated solution of sugar. Crystallizers control the conditions of the sugar solution, such as temperature, pressure, and concentration, to encourage the growth of sugar crystals.
- There are several types of crystallizers used in the sugar processing and refining industry, including **vacuum pans**, **batch pans**, and **continuous pans**. Vacuum pans are typically used for the initial crystallization stage, while batch pans and continuous pans are used for subsequent stages of crystallization and purification.
- Crystallizers operate by slowly cooling and evaporating the sugar solution, allowing the sugar to crystallize and grow into larger crystals. The process can take several hours to several days, depending on the specific type of crystallizer and the desired size and quality of the sugar crystals.

Crystallizers are used in various food processing applications to produce a wide range of products:

1. Refined sugar
2. Confectionery products
3. Jams and jellies
4. Baked goods
5. Dairy products



2/4

Working Principle

1. Supersaturation:

A supersaturated solution is created by dissolving sugar in water, at a high temperature. As the solution cools or the pressure decreases, the solubility of the substance decreases, creating a supersaturated solution that contains more of the substance than it would normally be able to dissolve.

2. Nucleation:

Crystallization begins when small crystals, known as nuclei, form within the supersaturated solution. These nuclei can be created by adding seed crystals or by simply allowing the solution to cool and reach a point where spontaneous nucleation occurs.

3. Crystal growth:

Once nuclei are formed, they act as a template for the growth of larger crystals. The conditions of the crystallizer, such as temperature, pressure, and agitation, can be controlled to encourage the growth of crystals of a specific size and shape.

4. Separation:

Once the desired size and quality of crystals have been achieved, the crystals are separated from the remaining solution using a filtration or centrifugation process. The remaining solution, which is now less concentrated, can be recycled back into the process.

The working principle of crystallizers involves creating conditions that promote the formation and growth of crystals from a supersaturated solution, leading to the production of high-quality crystals that can be used in a wide range of applications.

3/4

Market Scope

- One major application of crystallizers is in the production of refined sugar from raw sugar cane or sugar beet juice.
- The global **sugar industry** is a major consumer of crystallizers, with demand driven by the growing global population and increasing consumption of sweetened foods and beverages. The market for sugar crystallizers is expected to grow at a moderate rate over the next few years due to increased demand for high-quality refined sugar.
- In addition to the sugar industry, crystallizers are also used in the production of other food products, such as **confectionery**, **dairy products**, and **baked goods**.
- The **pharmaceutical industry** is also a significant user of crystallizers, particularly in the production of drug compounds and active ingredients. The demand for crystallizers in the pharmaceutical industry is driven by the increasing prevalence of chronic diseases and the need for more effective treatments.
- Other industries that use crystallizers include **chemical manufacturing**, **wastewater treatment**, and **mining**. The growth of these industries is expected to drive demand for crystallizers in the coming years.



4/4

Fact 5

Crystallizers are essential units in various industries, employing controlled cooling or evaporation processes to precipitate solutes from solution as crystals. Utilizing principles of nucleation and growth, crystallizers enable the production of high-purity solids from liquid solutions, offering precise control over crystal size and morphology. Their versatility and efficiency make them indispensable in pharmaceuticals, chemicals, and food processing sectors.

DECANTERS

FOR EDIBLE OIL SEPARATION



1/4

Decanters for edible oil separation are specialized machines used in the oil and gas industry to separate solid particles and liquids from crude oil. They are also used in the food industry to separate solid impurities from edible oils, such as vegetable oils, animal fats, and fish oils. Decanters use centrifugal force to separate the components of a mixture based on their density differences.

- The decanters for edible oil separation are typically large, high-speed machines that can process large volumes of oil in a short amount of time. They consist of a rotating drum or bowl that spins at high speed, separating the oil from the solid impurities. The separated oil is then discharged through an outlet, while the solid particles are discharged through a separate outlet.
- Decanters for edible oil separation are commonly used in producing vegetable oils, animal fats and fish oils. The decanters help to remove solid impurities such as fibres, proteins, and other contaminants that can affect the quality and shelf life of the final product.
- They are also used to improve the efficiency of the production process, reducing the time and energy required to produce large volumes of oil. Leading manufacturers of decanters for edible oil separation include Alfa Laval, GEA, ANDRITZ, and Flottweg.

Uses

1. Soybean oil: Decanters are used to separate the oil from the solid impurities in soybean oil.
2. Palm oil: Decanters are used in the palm oil production process to remove impurities and separate the oil from the water and solids.
3. Canola oil: Decanters are used in the canola oil production process to remove impurities and separate the oil from the solid materials.
4. Fish oils: Decanters are used in the production of fish oils to separate the oil from the solid materials, such as bones and skin.
5. Animal fats: Decanters are used in the production of animal fats to separate the fat from the solid materials, such as bones and tissue.



2/4

Working principle

- So, the decanters for edible oil separation are essential equipment in the production of a wide range of food products, helping to ensure that the final product is pure and of high quality.
- The working principle of decanters for edible oil separation is based on the difference in density between the various components of the oil mixture.
- In the production of edible oils, the crude oil mixture typically contains a combination of oil, water, and solid impurities. The decanter is used to separate these components into their parts so that the oil can be purified and prepared for consumption.
- The decanter operates using a centrifugal force that separates the components of the crude oil mixture based on their density. The oil mixture is fed into the decanter, where it is accelerated to a high speed, typically ranging from 2000 to 4000 rotations per minute.
- As the mixture spins, the solid impurities are forced outward by centrifugal force, and the oil and water are forced to the centre of the decanter.
- The separated oil and water are then removed through separate outlets, with the oil being further processed and purified through additional steps such as refining, bleaching, and deodorization. The solid impurities, which are removed through the decanter's outlet, can be processed, and used for other purposes.



3/4

Market scope

- The global market for decanters for edible oil separation is driven by the increasing demand for high-quality edible oils, particularly in emerging economies where population growth, urbanization, and changing dietary habits fuel demand.
- Decanter technology offers an efficient, cost-effective, and reliable way to separate the various components of crude oil mixtures, enabling producers to extract more oil from their raw materials and reduce waste. Furthermore, decanters are energy-efficient, reducing the carbon footprint of oil production.
- A few key players, including GEA Group AG, Alfa Laval AB, Flottweg SE, Andritz AG, and Hiller GmbH dominate the market for decanters for edible oil separation. These companies offer various decanter models and configurations, including two-phase and three-phase designs, horizontal and vertical orientations, and varying bowl sizes and capacities.
- The Asia-Pacific region is expected to be the fastest-growing market for decanters for edible oil separation, driven by the rising demand for edible oils in countries such as China and India.
- The market is also growing in Europe and North America, where producers are investing in new technology to meet consumer demand for high-quality, sustainable, and healthy food products. The decanter market for edible oil separation is expected to continue growing in the coming years, driven by increasing demand for high-quality edible oils and a growing focus on sustainability and environmental protection in the food industry.



4/4

Fact 6

Decanters are crucial in edible oil production, employing centrifugal force to separate oil from solids and liquids. In a continuous process, the decanter spins the oil-water mixture, forcing heavier phases outward while lighter oil collects at the center. Variable speed control and adjustable parameters ensure optimal separation efficiency. Decanters play a pivotal role in maintaining product quality and yield in the edible oil industry.



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