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Salt of the earth

Bleaching earths, used as part of the process that removes impurities from edible oils prior to final application, are a fast growing market that is estimated to be worth US$3.59bn by 2022. Rose Hales writes

Before vegetable oils can be safely consumed, they have to be processed in order to remove impurities, both for commercial and health purposes. A process known as bleaching involves the use of bleaching earths or clays. The term itself is misleading as colour removal is not the most important purpose of the bleaching process.

Vegetable oils contain contaminates that adversely affect the performance, appearance and taste of the oil. In order for it to be used in edible applications, the oil must meet high quality standards that require the removal of various impurities.

The bleaching process essentially removes some colour from the oil; reduces how much chlorophyll and carotinoids the oil contains; removes soap, gums and trace metals; and decomposes oxidation products.

Bleaching is performed prior to other processing steps such as hydrogenation, refining or deodorisation. Suppliers of the clays say that bleaching earth will accounts for 4-10% of overall refining costs, depending on a variety of factors including oil type, dosage, oil contaminent levels, specification and disposal cost.

What are bleaching earths?

Oils are bleached using a powdered, surfactant material. Simply put, the powder is mixed with water, and then added to the oil where they absorb unwanted impurities before they are removed from the oil again, taking the impurities with them.

Bleaching earths are generally composed of up to three types of clay minerals: bentonite, attapulgite and sepiolite. The minerals act as absorbers with capacity being dependent on mineralogical structure and properties, such as surface area, particle size distribution, porosity and surface activity.

Bentonites are a soft stone with the capacity to absorb substances dissolved in water and other liquids. The minerals have been formed over time due to the natural adaptation of volcanic ash.

Bleaching earths are found in mines around the world, including North America, South America, Europe, the Middle East and Asia.

Dry bleaching vs wet bleaching

The two different methods utilising bleaching clays in the refining process are dry bleaching and wet bleaching. According to Alfa Laval, dry bleaching is the traditional method used for bleaching oils and fats. It is most common in Europe and Asia, but is used worldwide.

The process first involves heating the oil, then mixing it with bleaching earths or activated carbon (or a mix of both). This process takes place under vacuum – which prevents oxidation – and with a sparging steam (the direct injection of steam in order to heat the oil with very high energy levels). Because the bleaching takes place under vacuum of about 70 torr, the humidity of the oil is greatly reduced.

Following the bleaching process, the powder is removed using pressure leaf filters and is collected in a buffer tank, which also operates under a vacuum.

Dry bleaching requires a much lower initial investment than wet bleaching. The operating costs are also significantly less due to the use of plate heat exchangers, which require lower consumption of utilities. The process is also relatively easy and straightforward and requires only minimum space for set-up.

Wet bleaching, on the other hand, involves the addition of water in the process. Water makes bleaching earths work more efficiently, which means that less can be used, and oil losses are also reduced. Wet bleaching is attractive due to the lower costs of the process itself, even though start-up costs are higher. Water is added in the form of a citric acid solution, after the oil has been heated and before the bleaching earths are mixed in. The citric acid helps to bind trace metals and decompose residual soaps.

Activated and natural

Natural bleaching earth is a type of bentonite or attapulgite clay, which is absorptive in its natural state. It is processed, but in a physical rather than a chemical way. Activated bleaching earth also comes from bentonite clay, but contains a higher proportion of montmorillonite. Activated bleaching earth is given a chemical treatment to alter the clay and give it properties that increase its bleaching potential.

According to Louis L Richardson in the paper *Use of Bleaching, Clays, in Processing Edible Oils*, activated clays are much higher in bleaching efficiency, in particular when used on very dark oils and those with a very high cholorphyll content. However, natural or physically activated bleaching earths do have their own uses due to their lower acid levels.

Activated bleaching earth market

In a new report on the activated bleaching earth market published in April, research carried out by Grand View Research Inc concludes that the market is expected to be worth US$3.59bn by 2022. The increased production of edible oils in the Asia Pacific region is cited as the key factor that will drive the market. In particular Malaysia, Indonesia, China and India are the main countries driving demand in the region, due to an increase in edible oil production on account of growing populations.

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A QUARRY ON THE ISLAND OF MILOS, GREECE WHERE BENTONITE IS MINED

In addition, the report found that Central and South America will also see a significant growth in the market, predicted to rise to a value of US$350M by 2022. Argentina's production of edible oils and fats is expected to increase in the period between now and 2022, which is further expected to increase demand for activated bleaching earths.

Market demand for activated bleaching earth was 5.98M tonnes in 2014 and was predicted to rise to 8.65M tonnes between 2015 and 2022. According to the report, the leading application segment, accounting for more than 80% of the total activated bleaching earth market, was edible oils and fats.

In addition to findings relating to the value of the market, the research also found that the activated bleaching earth industry is highly fragmented, and there are a large number of small players scattered worldwide.

Spent bleaching earth (SBE)

A waste material is produced through the edible oil bleaching process, which is called spent bleaching earth (SBE). Because of the nature of the bleaching process, SBE contains a percentage of oil. According to the report, *The Effect of Spent Bleaching Earth Ageing Process on its Physicochemical and Microbial Composition and its Potential Use as a Source of Fatty Acids and Triterpenes*, despite many years of research, this waste material is still a "serious and unsolved, economic and ecological problem".

The report says that in 2014, 1-2M tonnes of SBE was produced by the industry worldwide, and the SBE contained between 25% and 40% oil, as well as various contaminants that it removes in the process. The SBEs have a diverse composition, which makes them difficult to manage and dispose of. They contain water-insoluble substances such as fatty acids, macro- and micro-elements, plant pigments and heavy metals.

Decomposition in the environment is slow and inhibited and ecological reasons usually prevent this type of disposal. The report also dissuades against open-air storage, saying it could cause spontaneous combustion. In the EU, SBE is classified as a hazardous waste.

Bleaching earth companies try to reduce the amount of SBEs produced in the process, as well as how much oil the earth contains. In addition, finding a use for SBEs or SBE oil can help to reduce waste. For example, Neste Oil has been using SBE oil as a raw material in its NEXBTL renewable diesel base since 2013.

A report in 2013 written by Soh Kheang Loh *et al* demonstrates how SBE could be used as a bioorganic fertiliser. The SBE was co-composted with some agricultural and palm oil milling by-products in order to produce a fertiliser. The report says that due to adequate amounts of "beneficial

mineral elements; improved organic carbon; cation exchange capacity (CEC); water-holding capacity and carbon to nitrogen (C:N) ratio", the SBE fertiliser had a positive impact on soil physical attributes.

Advancements & developments

Recent developments in the bleaching earths industry include the introduction of speciality bleaching earths to be used to lower the amount of 3-chloropropane-1,2-diol (3-MCPD) in edible oils and fats.

3-MCPD is a chemical compound that can be created in some margarines, vegetable oils and animal fats when heated. It is suspected of being carcinogenic and genotoxic, and tests are carried out to ensure foods do not contain dangerous amounts. The European Food Safety Authority (EFSA) has acknowledged the health risks associated with 3-MCPD, and other research institutes are assessing its presence in refined edible oils and fats.

According to bleaching earth supplier Clariant, specific bleaching earths can be utilised to reduce the production of 3-MCPD during the heating and refining process.

In the book, *Processing Contaminants in Edible Oils*, B Matthäus and F Pudel recommend the "use of natural bleaching earths and acid-activated bleaching earths with more neutral pH values", in order to significantly decrease the content of 3-MCPD in edible oils.

A study conducted on behalf of AOCS in 2014 researched the effects of degumming and bleaching on 3-MCPD esters formation during the physical refining process of palm and rapeseed oils. Results showed that the lowest levels of 3-MCPD were detected when the oil was degummed with water and bleached using natural bleaching clays. Levels were at their highest when the oil was phosphoric acid degummed and bleached with acid activated bleaching clays. "The findings revealed the contribution of acidic conditions on the higher formation of 3-MCPD esters," the report concluded.

Clariant introduced four new grades of bleaching earth in 2013, which were designed to improve the reduction of 3-MCPD of up to 30%.

Greek company Geohellas specialises in physically activated, attapulgite bleaching earth most suitable for a mild contaminant removal process and for companies trying to avoid acid, it says. In particular, the company says its product is used by those wishing to create an organic edible oil, and for the reduction of 3-MCPD (due to low acidic levels). ●

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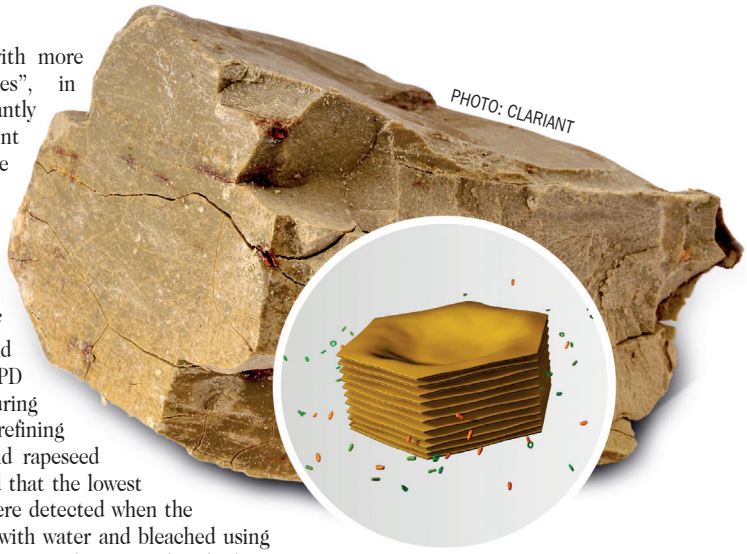

A CLOSE-UP VIEW OF THE TONSIL BLEACHING CLAY SOLD BY CLARIANT, AND A DIAGRAM OF HOW THE LAYERS AND POROUSITY OF THE CLAY WORKS TO REMOVE IMPURITIES

Clariant expands Tonsil production in Mexico

Clariant has increased production capacity for its Tonsil bleaching earths and Tonsil Coarse Optimized (CO) grades at its Puebla site in Mexico by 30%. The additional capacity came on stream in April, concluding two years of work to expand the facilities.

Pueblo is Clariant's Functional Minerals unit's second biggest bleaching earth production site. It is close to the company's mine and the supply chain that connects it to customers in North and South America.

According to Clariant CEO Hariolf Kottmann: "This latest expansion will enable us to respond to new market opportunities being created by rising demand in both North and South America."

The expansion in Mexico is part of Clariant's multimillion Swiss franc expansion plan for bleaching earths, which will include further investments in Mexico, Turkey and a new site in Indonesia.

New applications for physically activated MAK

Geohellas produces the MAK series physically activated bleaching earths, designed specifically for oxidation-sensitive oils. These products are made from attapulgitic clay, selectively mined in northern Greece.

In the production of MAK, Geohellas employs mechanical and thermal methods to physically activate the clay's high natural porosity and surface area. Because the activation process does not employ acids or chemical additives, MAK is ideal for the production of speciality, as well as high spec commodity oils, the company says.

Although MAK was initially designed for a niche markets (such as speciality oils, omega fish, olive and organic oils), Geohellas says the product has now proven itself very effective in a wider range of oil types. These include oils where acid-induced 3-MCPD cannot be tolerated. "Thus, with physically activated MAK, the company's clients have found that they do not need to sacrifice decolorisation for oil quality, and can have both – reducing the tendency for unwanted by-product formation," Geohellas says.

Oil-Dri's Select line helps to save water

Water conservation is a critical issue worldwide, says Oil-Dri. "Countries across the globe are keenly aware of current water usage levels and the need to manage this resource for the future. One country in particular, India, is facing an acute water shortage. Groundwater levels have dropped drastically resulting in drought conditions, electrical shortages are common from lack of water to generate steam, and very little water is left in many reservoirs. Companies are increasingly aware of the benefits of conservation to drive down escalating costs of water," the company says.

Oil-Dri's Select line of adsorbent technology products offer refineries an opportunity to save on water usage costs. "Using Select allows for the elimination of water wash centrifuge units. Select achieves similar results to water washing, but cuts down on overall water use and eliminates oil loss in waste water streams off the centrifuge. The adsorbent is best added in a dedicated slurry tank before the addition of bleaching clay," Oil-Dri says.

Recently, Oil-Dri has promoted Select as a water wash centrifuge replacement to water-starved markets as a conservation tool. "Customers are producing high quality oil while seeing a reduction in water usage, achieving significant savings in water related costs, and doing their part to help with the water crisis."