Photo: Adoe Stock

Finding value in waste

Extracting oil from spent bleaching earths using solvent extraction offers the possibility of converting a waste product into one with value *Gabriele Bacchini*

The last three decades have seen fast growth in vegetable oil production, with worldwide output now totalling more than 200M tonnes/year.

The growth has been spurred by increased human consumption, as well as expanding biodiesel production and the growth of the oleochemicals market connected to the personal care industry.

Increased vegetable oil production has also led to greater output of some wastes and by-products, mainly from the refining process. By-products such as acid oils, fatty acids distillate and palm oil mill effluent (POME) have become more important in some specific industries.

One such industry is biofuels, where subsidies allocated by different countries during the last decade have incentivised the use of low grade feedstocks such as used cooking oil (UCO) and acid oils.

Spent bleaching earths is another by-product which remains under discussion today, despite efforts to develop more sophisticated technologies to utilise this waste.

It is estimated that about 1M tonnes of spent bleaching earths – with an average oil content of 20-25% – are produced each year, based on the current vegetable oil production rate and assuming an average of 0.5% of bleaching earths consumed per tonne of oil.

This waste material is a potential hazard as it poses a risk of spontaneous combustion, making it dangerous to transport for proper disposal. In the refinery plant, spent bleaching earth also poses the same spontaneous combustion risk, making the site management of this waste very important.

At the same time, the possibility of recovering up to 200,000-250,000 tonnes/year of oil entrapped in spent bleaching earths presents an opportunity to recover a feedstock for non-food applications.

Oil extraction

During the last few years, many industrial operators have been studying the best technology to extract oil from spent bleaching earths to maximise oil recovery.

There are several technology options, some proven and some still in the development/pilot plant stage, but the most common method is solvent extraction. Solvent extraction technology is well known and widely used, and is the basis for most of global vegetable oil production. The most critical part of the whole process is the extraction phase, where the oil content is extracted using hexane as a solvent. ▶

In terms of oil extraction from spent bleaching earths, a typical example is shown in Figure 1 (*see right*).

The main difference in this process is in the extraction step itself: in solvent extraction of vegetable oil, there is a panel from the appropriately designed and upstream seed preparation unit that is fed to the extractor (belt or rotary type), where this panel is flooded by the hexane to extract the oil.

This approach is not recommended for oil extraction from spent bleaching earths. Instead, spent bleaching earths are transformed into slurry using hexane with a mixing reactor: the size of the reactor and the duration of the slurry formation is based on a pre-determined residence time, part of the know-how of technology providers.

The slurry formed in the batch reactor is then filtered continuously through an appropriately-sized continuous vacuum filter to remove solids from the miscella.

In some processes, it is even possible for the filter cake on the filter leaves to be subjected to a second wash using fresh hexane required for the next batch, to allow for the total removal of all residual oil in the spent bleaching earths.

The miscella distillation, as well as the desolventisation process, are both very similar to the typical vegetable oil extraction process.

The typical performance of this technology is significant: to obtain a residual oil content in the spent bleaching earth below 1%, less than 600kg of steam and 4.5 kWh of electric power are normally required.

These numbers are dependent on the size and the location of the plant itself, but can be used as a starting point.

The vegetable oil extracted is not suitable for the food industry, but there are various applications in the non-food industrial production that make this oil commercially attractive.

These range from the biofuels business to the downstream oleochemicals industry (for soaps, special esters etc), depending on the characteristics of the extracted oil.

The extracted oil requires some further processing (bleaching or cleaning with some filter aid) to remove some contaminants still present.

However there are widely available technologies that can be easily implemented to achieve this.

The spent bleaching earths, thanks to the drastically reduced oil, do not present a spontaneous combustion risk.

They are more stable for transport and disposal and are also suitable for other applications that can be further evaluated, such as for cement bricks. This is an important parameter for the producer as the spent bleaching earth disposal costs can be turned into revenue (however minimal) with a positive impact on the overall budget.

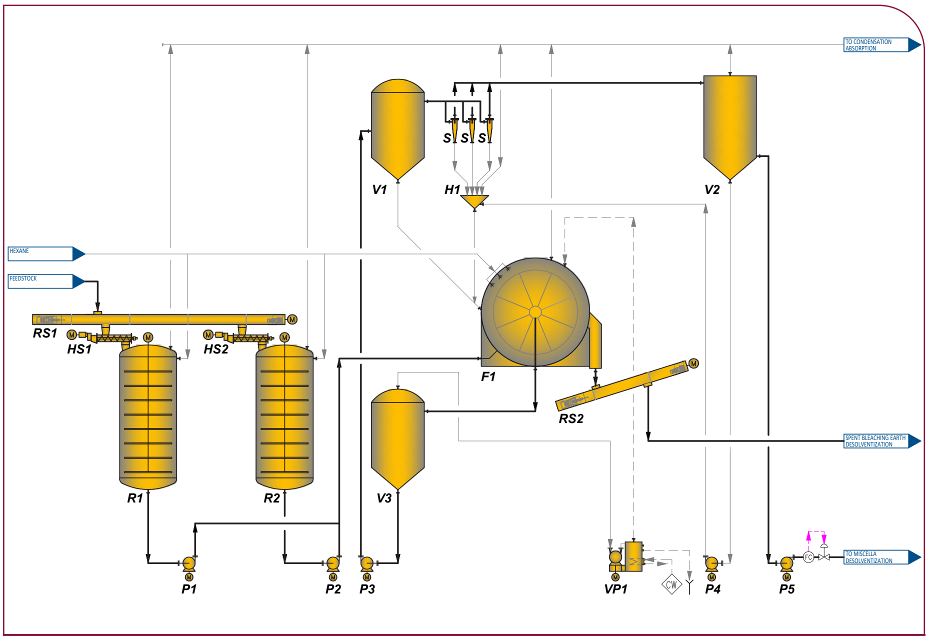

Figure 1: Solvent extraction from spent bleaching earths

Source: CM Bernardini International

Factors to consider

Looking at the data, the solvent extraction process can seem to be a panacea solving most, if not all, of the problems faced by entrepreneurs in the industial sector, transforming a hazardous waste into a product much easier to manage and with a value capable of delivering interesting returns.

However, there are some factors to be considered before installing a new extraction plant of this type.

The first point is that although the operating costs are not too high, the initial investment could make this type of unit economically unviable for smaller sized plants.

The optimal plant size should be evaluated carefully, taking into account the logistic related to the collection of spent bleaching earths from the vegetable oil refineries, and the risks connected to the transport activities.

The installation of an industrial extraction plant for processing spent bleaching earths produced in remote locations, especially in regions where logistics are strongly influenced by an under-developed motorway system, could invalidate any feasibility study conducted.

The other major point is the use of solvent, since solvent extraction plants are classified in terms of explosiveness according to the solvent used.

Most companies would prefer to install the spent bleaching earth extraction plant in an area where a vegetable oil extraction plant is already present, in order to minimise the associated risks of area classification.

The main idea behind this is that having personnel on the existing site who are already trained in the operation of solvent extraction plants is considered an advantage.

In this way, strict compliance with all required safety regulations is guaranteed.

However, having two of these plants – processing different types of feedstock in the same area – might not be so easy to manage, due to the logistical spaces and storage areas needed to be managed simultaneously.

Detailed feasibility studies must be conducted to assess all the above points, to ensure the profitability of the investment and to establish the most appropriate configuration to achieve a return on the initial investment.

Conclusion

The vegetable oil industry is looking for new opportunities to increase its revenues and reduce the risk of spontaneous combustion by further processing of spent bleaching earths.

Extracting oil from spent bleaching earths using solvent extraction is a possible solution, based on existing, proven and robust techologies, leading to a future where much more waste can be converted into high value products. •

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