Use or Disposal of By-Products and Spent Material from the Vegetable Oil Processing Industry in Europe

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ABSTRACT

The tendency in the oil and fat industry in Europe as far as by-products and spent material are concerned is to use and regenerate as much as possible for chemical-technical purposes. Materials with a high thermal value which are not suitable or profitable for use in chemical-technical products will in the future probably be utilized as a fuel in combination with fuel oil. By-products and spent material that cannot be exploited in the manners outlined above will be deposited in dumps. Incineration is another possibility. However, the quantities of waste must be of a considerable magnitude if this method is not to be too expensive.

INTRODUCTION

Use and disposal of by-products and spent material remains one of the major problems of the fats and oils industry today.

Regulations for disposal are becoming stricter. The deposit areas must be carefully chosen according to special directions, and the environmental conditions of these areas must be checked regularly.

The tendency in the oil and fat industry is to determine carefully the type and amount of by-products and spent material in the first place in order to find a suitable way of regeneration or application, and as an ultimate alternative to use the possibility of depositing in waste areas.

Process waters containing various types of by-products are often treated separately for extraction of these by-products before these waters are combined for final chemical and biological treatment. In this way, the amount of sludge from the chemical and biological treatment to be deposited is minimized.

BY-PRODUCTS FROM STORAGE OF CRUDE OIL

We make a distinction between two types of foots obtained when storing crude oils, namely, foots from marine and foots from vegetable oils. Both these types contain ca. 40-60% oil. The foots of the marine type are treated for separation of oil, which is used in the manufacture of fatty acids, and the residue is deposited. Foots from vegetable oils are suitable for use in animal feedstuffs.

BY-PRODUCTS FROM REFINING

The most common way of treating the soapstock obtained as a residue from alkali refining is to split it with acid in order to obtain the crude fatty acids. The higher the content of fatty acid, the more valuable is the crude fatty acid material, and with today's methods a total fatty acid content of ca. 95% is often achieved. This crude fatty acid is either regenerated by distillation and fractionation on the spot or is sold untreated for various technical purposes. Compared with the oil, the value of the fatty acid is considerably lower. The tendency has therefore become that much money is spent on systems which automatically register the exact figure or magnitude of losses in centrifugal refining, making it possible to minimize these losses during operation.

When regenerating the soapstock to distilled and fractionated fatty acids, two types of less valuable by-products are obtained, namely the unseparable oil emulsion and pitch.

In certain fatty acids, an oil emulsion is obtained as an intermediate phase between fatty acid and water after separation. The oil emulsion has usually been discarded.

The pitch obtained as a residue in distillation and fractionation of fatty acids has often been sold as a technical fat, used, for example, in road-surfacing materials. However, the demand is not very dependable.

The new trend is to use these two types of by-products in a mixture with fuel oil in steam boilers. However, the emulsion phase should be dried before being mixed with the fuel oil in order to avoid corrosion in the mixing equipment. Five to ten percent of these by-products can, without any problem, be added to the fuel oil.

All contaminated water from the soapsplitting, and the subsequent wash of fatty acids, is conveyed to a basin for flotation at pH 2. The fat accumulated on the surface goes back for regeneration into fatty acid. In this way, a maximum amount of fat is recovered, and, at the same time, the quantity of impurities in the water which is to be chemically and biologically treated is minimized.

TREATMENT AND DISPOSAL OF SPENT BLEACHING EARTH

The most common way today is to discard to the dump spent bleaching earth containing ca. 40% of oil directly from the filters. The bleaching earth often has a strong odor, and spontaneous ignition easily occurs in contact with air, particularly if the bleaching earth contains highly unsaturated oils. When dumped, the bleaching earth must therefore be covered with soil or sand.

Since it is possible to remove a large portion of the oil in the bleaching earth, this procedure will in the future most probably become a requirement before dumping.

Extraction of Oil from Bleaching Earth in Closed Disc Filters

In those cases where closed disc filters with a centrifugal discharge are being used, the content of oil in the filter cake can be reduced by means of hot water washing, steam extraction, or solvent extraction, usually hexane.

By use of hot water and steam, the content of oil in the cake can be reduced to 25-35%, whereas if using hexane it is possible to reduce the oil content to ca. 10%. These oils are good and usually reenter the process as crude or partly refined oils.

Preparations must be made for this type of oil extraction when the filters are being installed; furthermore, in the case of solvent extraction, special conditions are stipulated for buildings and environment.

One example of solvent extraction in filters (1) is shown in Figure 1. After completion of extraction and drying, the bleaching earth is slung into a container, where it is suspended in water in a ratio earth:water of 1:1.5. Direct

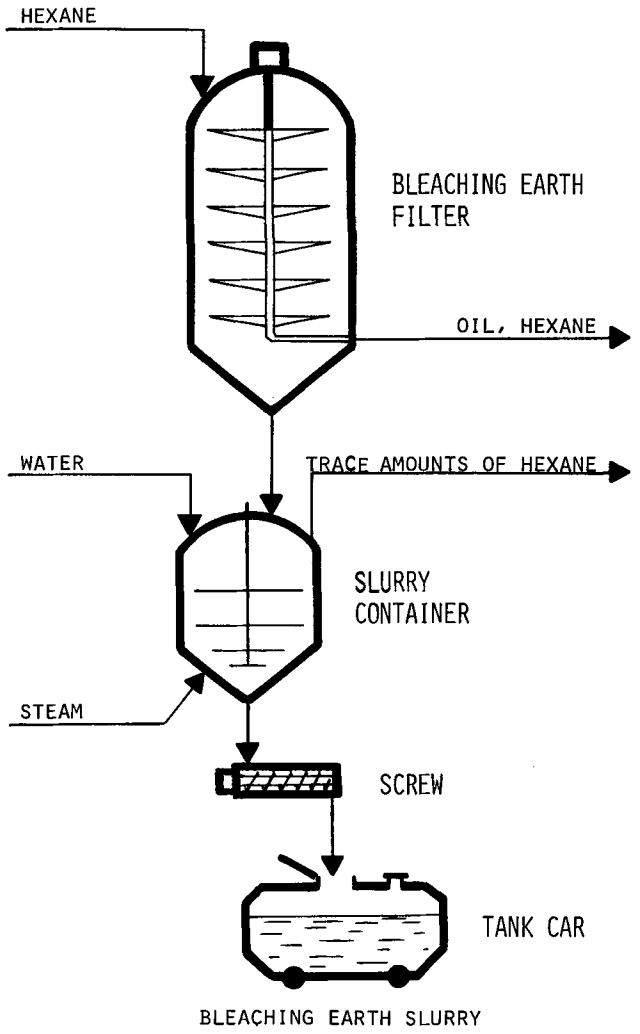

FIG. 1. Treatment of the hexane-extracted bleaching earth.

steam is then blown through the slurry for a final evaporation of hexane. Finally, the bleaching earth is dumped as a water slurry. This type of disposal is, however, less common and will probably become more difficult in the future.

Extraction of Oil from Bleaching Earth in Separate Plants

Other methods used for reducing the oil in bleaching earth after it has left the filters are:

1. Extraction using a polar or a nonpolar solvent
2. Extraction of the bleaching earth in a mixture with oil-yielding seeds
3. Extraction of fat from the bleaching earth by boiling a water suspension of bleaching earth containing a surface active agent.

In all types of extraction, it is important, both as regards yield and quality of oil, that the bleaching earth is taken directly from the filters. This will keep oxidation of the oil at a minimum.

Solvent Extraction

It is most common in solvent extraction to use nonpolar solvents, which, contrary to polar solvents, do not dissolve, for instance, adsorbed pigments from the bleaching earth.

In order to make the setting up of a new plant profitable, the amount of used bleaching earth per 24 hr must be at least 6 tons.

Extraction of bleaching earth in a mixture with oil-yielding seeds might be a possibility, provided that bleaching and extraction are adjacently located. Included in the disadvantages connected with this procedure could be, however, that the content of inorganic substances in the

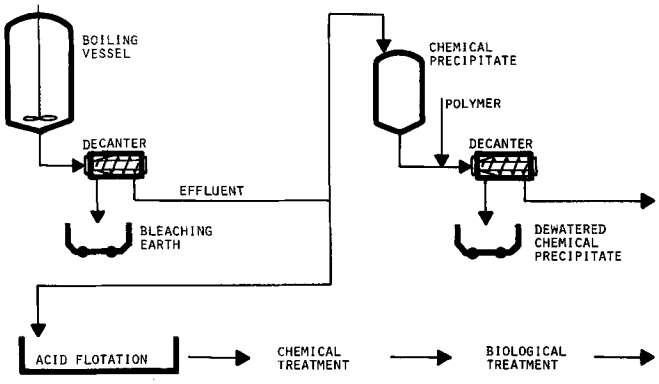

FIG. 2. Treatment of effluent.

meal is increased beyond the level of acceptability. Furthermore, if the oil from the bleaching earth is of a low quality, the oil quality from the seeds will be reduced.

Boiling the Bleaching Earth in a Water Suspension Containing a Surface Active Agent

By boiling the bleaching earth which is suspended in double the amount of weight of water, containing 1.5-2.5% of concentrated lye calculated on the amount of bleaching earth, the oil can be extracted from the bleaching earth, whereupon it accumulates on the surface of the slurry. The result is a dark colored oil which can be used exclusively for technical purposes, e.g., fatty acid production.

When the oil has been extracted, the homogenous bleaching earth slurry is processed in a solid bowl decanter centrifuge. By adapting a decanter to suit the purpose, it has been possible to achieve a type that by centrifugation separates 85% of the bleaching earth from the water slurry. The bleaching earth obtained is solid, containing ca. 50% water, 45% bleaching earth, and 5% oil, irrespective of whether or not the oil was extracted from the slurry before being treated in the centrifuge. The bleaching earth, a light grey color, is almost odorless and does not ignite spontaneously. Two different methods for further treatment of the effluent with its content of bleaching earth containing, in most cases, some oil are shown in Figure 2.

The water phase is either subjected to acid flotation, chemical precipitation, and biological degradation, or joins the chemical precipitate from the chemical purification step and is centrifuged in the presence of a polymer.

One advantage of this method is that the bleaching earth obtained can be used as land-filling material or as a replacement for earth or sand for covering of refuse dumps.

Yet another advantage is that, by suspending the bleaching earth in water directly after filtering and by pumping it to the processing plant, a closed system, and therefore clean handling, is achieved. A great deal of manual handling can be avoided in this way.

SPENT MATERIAL FROM HYDROGENATION

Catalyst

The most common way to dispose of a used catalyst is to sell it for regeneration of the nickel content. This sale is usually made to the suppliers of the catalyst. A spent catalyst to be sold should contain at least 10% nickel, and payment is made by the content of nickel in the residue.

BY-PRODUCTS FROM DEODORIZATION

Deodorization of oils and fats produces two types of by-products, namely, entrainment oil and distillate.

Uses of Entrainment Oil

This by-product consists of a neutral oil. If the quality is high, it usually goes back into the process as a crude oil.

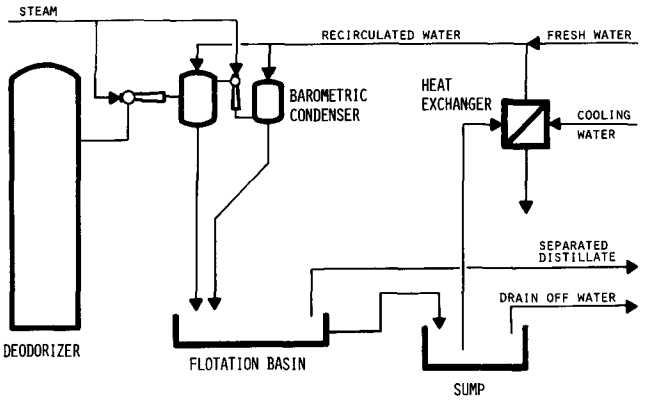

FIG. 3. Recirculation system for condenser water.

Other possible uses for this oil are in feedstuff or as technical fat, either as a neutral oil or as fatty acids. How the fat is used often depends upon the speciality of each industry.

Recovery of Distillate from Deodorization

This can be performed in two fundamentally different ways. One is condensation of the distillate in a scrubber, where the scrubber liquid consists of a neutral fat or a condensed distillate. This type of scrubber is considered to be most efficient if placed before the booster ejector.

The other method is to separate the distillate from the condenser water coming from the barometric condensers. The principle of this system is outlined in Figure 3. The fat is separated by flotation and is scraped off by means of surface scrapers into a collecting tank. From this tank, the fat is conveyed to a vessel for boiling with sodium chloride. The processed water is drawn off from the bottom of the flotation basin and is collected in a sump. After cooling the water to ca. 5 C in heat exchangers, the water is recirculated to the barometric condensers. To avoid accumulation of impurities in the system, 5% of the water is drained off and conveyed for chemical and biological treatment. This amount of water is replaced with fresh water after the heat exchangers. These are equipped with a built-in cleaning system for cleaning with caustic, nitric acid, and water. The washing liquids are collected separately, neutralized, and then conveyed to the flotation basin.

Also, in cases where a scrubber condenser is installed, the tendency is to recirculate the condenser water, since this water usually contains too many impurities to be discarded directly to the sewer.

Distillate from Deodorization

Certain difficulties are involved in the disposal of distillate from deodorization. The most common ways of disposal today are to deposit in a refuse dump; to treat in a putrefaction chamber, in most cases in local government sewage plants; and to sell the distillate for technical fields of application. The first two alternatives are not very attractive. The third alternative is hardly profitable, and future marketing possibilities are uncertain.

Owing to the high amount of unsaponifiables in the distillate, the composition is generally 1/3 each of fatty acids, fat, and unsaponifiables. The distillate, for example is not suitable for use as a raw material for fatty acids.

To use the distillate in feedstuff is also a doubtful possibility, since pesticides which might be present in the oils will enrich in the distillate.

A safer way of disposal is to utilize the energy value of the dry distillate by mixing the distillate with fuel oil used in steam boilers. It has been proved that this method works with up to 10% of distillate.

DEPOSIT AND COMBUSTION OF WASTE

Disposal of waste of no utility may be accomplished either by sending it to the dump or burning it.

Dump

The disadvantage of dumping waste is that it might give rise to severe water and air pollution problems. Authorities are now establishing strict directions for the selection of deposit areas.

If deposit is to be made on a ground layer, this should consist of earth that is impermeable to water. If rock is used, this should preferably be primary rocks with few cracks and protected by a layer of earth. It is also important that no stability problems arise in the deposited waste or in the ground layer.

Nor must the surface water from surrounding areas be allowed to come into contact with the waste. If natural conditions preventing this are lacking, special arrangements can to some extent take care of this. A well-defined outflow area with surface water conduits should be arranged in such a way that the surface water leaves the area from one point. Leach and surface water from the deposit area must not be led into the recipient water source in a polluted condition but must pass through a sewage treatment plant. The deposit site should be located where the groundwater is not likely to be exploited in the foreseeable future. Furthermore, the flow direction of the groundwater should be clear-cut, and the speed of flow should be low to moderate.

Combustion

Combustion of the waste, e.g., in a fluidized bed incinerator, is another possibility. All types of waste, with the exception of catalyst residues, can be mixed and burnt without any addition of a supporting fuel, provided the energy content of the mixture is not less than 2,000 kcal/kg.

The solid residue of combustion is a sterile waste which can be used as a filling material.

Cleaning of the flue gas from these incinerators should be carried out by dust collecting, and wet traps for gaseous emissions will most probably also be made a condition.

REFERENCE

1. Meiners, J., Fette Seifen Anstrichm. 6:370 (1971).