Oil Recovery from Spent Bleaching Earth and Disposal of the Extracted Material

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ABSTRACT

Methods for recovering oil from spent bleaching earth are described. Blowing steam and circulating hot water through spent bleaching earth reduce its oil content to only ca. 25% and 20%, respectively. Mixing the cake with milled oilseed may spoil the fresh oil. Hexane extraction of spent earth with hexane is economically feasible for expensive and relatively stable oils only. Because of its simplicity and low cost, extraction with an aqueous solution of soda and salt is economically feasible. The problems with respect to the disposal of the extracted material are discussed.

INTRODUCTION

Bleaching of edible oils is predominantly done with acid-activated clays, sometimes also with added activated carbons. The purpose of bleaching is not merely to remove coloring matters, but also soap, gums (particularly phosphorus compounds), metals like iron and nickel and oxidized compounds. There are indications that the clays also adsorb polymers, probably polar oxypolymers.

Spent bleaching earth removed from the filters may contain 20-40% oil. This oil represents a large part of the cost of bleaching and it is important to recover as much as possible of it. However, too exhaustive recovering methods may cause desorption of the impurities adsorbed on the clay, resulting in an oil of low quality. There are several methods to recover the oil retained in the filter residue. This recovery can be accomplished on the cake while it is still in the filter, or after it has been removed from the filters.

METHODS FOR OIL RECOVERY

Blowing Steam Through the Cake in the Filter

Steaming of the cake may reduce the oil content of the cake to ca. 20%. However, it is advisable not to reduce the oil content to below 25%, because the wetting power of the steam may cause some desorption of the impurities adsorbed on the clay, which lower the quality of the recovered oil.

Furthermore, in a cake of low oil content, the oil (in a finely dispersed form in the clay particles) oxidizes rapidly when exposed to air. In the case of highly unsaturated oils, such as fish and also soybean oils, the material may catch fire.

Circulating Hot Water Through the Cake in the Filter

In this method, hot water of ca. 95 C is pumped through the cake at a rapid flow rate for ca. 30 min. In this way the oil content of the cake could be reduced to ca. 20%.

Circulating Hexane Through the Cake in the Filter

When filtration is finished, the cake is blown cautiously with steam. Subsequently, so-called half-miscella, containing ca. 3% oil, is circulated through the cake for ca. 20 min. The resulting miscella, containing ca. 12% oil, is distilled. The half-miscella treatment is followed by a washing with fresh hexane. Finally the cake is blown with steam and removed from the filters. Obviously, special provisions as to buildings and environment should be made in connection with the use of an inflammable solvent like hexane.

A typical installation, processing on the average 1000 tons of spent earth per year, installed in 1980 cost Dfl. 285,000. Operating costs excluding labor and maintenance are as follows: interest plus depreciation (30% of investments), Dfl. 85,500; steam (3,500 tons at Dfl. 40.00/ton), Dfl. 140,000; hexane losses (30 tons at Dfl. 1,300.00/ton), Dfl. 39,000; electricity (54,000 kWh at Dfl. 0.20/kWh), Dfl. 10,800; cooling water (220,000 m^3), Dfl. 11,000; giving a total of Dfl. 286,300.00.

On average, the oil content of the spent earth before and after extraction is 30% and 5%, respectively, and the total yield is 263 tons of oil. The recovery cost – excluding labor, maintenance, etc. – is Dfl. 1,089/ton of oil. The method is only interesting for the more expensive oils like peanut, olive oil, cocoa butter, etc. Since the dry extracted clay is dusty, it is normally sprayed with water. For the present, the extracted material can be dumped in public disposal sites, provided that the quantities are not too big.

Mixing the Cake with Milled Oilseed and Thus Pass It Through the Extraction Process

This method is still being used in some extraction plants with refining facilities; however, it is not without concern. First, the clay increases the mineral content of the meal. Second, the spent earth containing highly unsaturated oils like soybean oil presents a fire hazard. Third, with highly unsaturated oils like soybean oil in the clay, deterioration takes place rapidly as shown in Table I.

The oxidation products and the polymers – most probably oxypolymers – obviously spoil the fresh oil extracted from the oilseed.

Hexane Extraction of the Cake after Removal from the Filter

As indicated before, exposure of the cake to the air (which is inherent in removing it from the filter), causes a rapid deterioration of the fatty matter. This is particularly the case with highly unsaturated oils like soybean oil. Furthermore, as already mentioned with the hexane circulation method, the costs for recovering the oil with hexane are high. The method is only interesting for expensive, low unsaturated and relatively stable oils.

Boiling the Cake in Water Containing Soda and Salt

An old method for recovering oil from spent earth by boiling it in water containing 3% sodium carbonate and 3% salt has entered the picture again, in the last couple of years. The method is simple and cheap. However, the recovered oil is of low quality and is suitable for technical purposes only, like mixed feed. The composition of the extracted material, so-called slurry, is shown in Table II.

As a result of present-day restrictions imposed by environmental control laws, disposal of the slurry meets with many problems. Boiling the clay with sodium carbonate converts it to a bentonite; the suspension is completely impermeable and can hardly be dewatered by means of centrifuging or filtration.

The suspension becomes permeable and filterable after

TABLE I

Properties of Soybean Oil Extracted from Spent Bleaching Earth with Hexane

	Spent bleaching earth	
	3 hr after removal from filter	stored at 70 C for 40 hr
Extraction yield (%)	28.0	4.5
Properties of extracted oil:		
Acid value (mg KOH/g)	7.8	61.2
Peroxide value (meq/kg)	44.8	13.7
Iodine value (Wijs)	108.2	43.1
Polymers (%)	17.3	22.3

TABLE II

Composition of the Slurry Remaining after Extraction of Spent Earth with Water Containing Sodium Carbonate and Salt

	Percentage
Water	60 - 70
Salt (NaCl)	2 - 3
Sodium bicarbonate	3 - 10
Clay	25 - 40
Nickel	0.00 - 0.02

lowering its pH to ca. 4 or less, and/or treatment with calcium salts like calcium chloride or sulfate. In this way the water content of the slurry can be reduced to ca. 40%, resulting in a semisolid and permeable sludge. There are several possibilities to dispose of this sludge, but the most promising are for cement manufacture, as a source of silicium dioxide, or mixing with sandy oils.

The first alternative is possible only when the distance between the reclaiming plant and the cement factory is not far.

The second alternative – mixing with sandy soils – can be applied successfully in limited proportions. The results of growing experiments with sweet maize sown on sandy soil mixed with bentonite slurry and sludge having been treated with calcium sulfate, are encouraging. The maximum amounts that can be mixed with 1 m^3 of sandy soil are about 100 kg for the bentonite slurry and ca. 200 kg for the sludge having been treated with calcium sulfate.