C-19 polyamides (and hence the MW) was significantly lower than that of the dimer polyamide, the strength and adhesive properties were comparable with the exception of low temperature flexibility.

Comparison of Polyamides Derived from Koch C-19 Diacid and Hydroformylation-Type C-19 Diacid

We found it interesting to compare the properties of similar polyamides prepared from C-19 diacid derived from the Koch process and from C-19 diacid prepared by a hydroformylation-type process and obtained from the BASF Corporation.

From Table VI it can be seen that both C-19 diacids gave polyamides with similar tensile strengths at similar softening points. However, the Koch C-19 diacid-derived polyamide had a much lower melt viscosity and a higher elongation. It also had better adhesion to a metal surface – in fact, it had to be chipped off to be removed, whereas, the hydroformylation-type C-19 diacid-derived polyamide broke off much more easily.

The properties of the polyamide derived from the hydroformylation C-19 diacid were distinctly better than those reported by Kohlhase et al. (9) for a similar polyamide made from the same type of C-19 diacid, hexamethylenediamine, and a slightly lower proportion of adipic acid than we used. It appears from a review of their procedure and those in relevant patents (8,10) that the lack of a vacuum stage at the end of their polymerization may have been responsible for the low viscosity and tensile strength which they achieved. With this modification, we believe that polyamide hot-melt adhesives with good properties could also have been prepared from their C-19 diacid.

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Elimination of Air and Water Pollution by Double-Stage Scrubber[1]

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ABSTRACT

This new scrubbing system has been developed to eliminate entirely air pollution caused by water cooling towers during oil or fat deodorization. It also minimizes water effluent. In industrial application for more than one year, this system is based on the action of two scrubbers placed in series. The first scrubber is a conventional one, whereas the second uses concentrated cooled brine circulating in closed circuit as the condensing medium. A thorough purification of water vapors is thus achieved before the volatiles from the deodorizer enter into the high vacuum bosters. As a practical result of this special scrubbing process, the condensing water of the barometric condensers can be entirely recycled and this water is cooled by means of clean water in a surface heat exchanger requiring minimum maintenance for cleaning.

INTRODUCTION

The severe regulations imposed in all countries to fight pollution caused by the wastewater effluents of various industries are well known.

The leading executives in the Oil Milling Industry are directly concerned by these regulations, for a good deal of wastewater results from processing edible fats and oil. These effluents do indeed contain soaps, fatty materials, and organic components and other pollutants in general.

Purification of this wastewater is desirable in all cases. In the annual balance sheet of a refinery, wastewater purification means an increase in operating costs, the amount of which depends on: (a) The location of the factory with respect to neighboring living quarters and the pollution regulations of municipal or state authorities; and (b) the flowrate and the degree of pollution of the wastewater, either the direct discharge of used water to the river or stream, or the discharge of the same to the public waste treatment works.

In the present paper, we will focus on the effluents from a fat and oil deodorizing plant which, in environmental legislation, is called "condensing cooling water."

During the deodorizing process, a great deal of undesired volatile constituents like fatty acids, aldehydes, ketones, sterols, etc., which are indeed eliminated from the oil by the combined action of vacuum and stripping steam, are finally condensed in the cooling water of the barometric condensers.

Apart from these condensable volatile organics, a certain entrainment of the processed product occurs, which escapes from the deodorizer and finally also adds to pollution of the barometric condenser water. In addition to this water pollution, the use of cooling towers to recycle this water leads to air pollution.

PROCESS

For several years, modern continuous deodorizing plants have been equipped with partial condensation systems to capture the majority of fatty acids. The use of these condensations serves the simple purpose of decreasing sticky deposits in the cooling towers, and recovering some valued volatile materials coming from the deodorizing of certain

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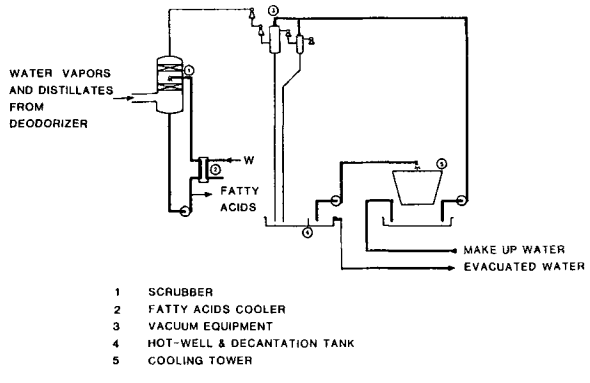

FIG. 1. Conventional scrubbing system (cooling water recycled through cooling tower.

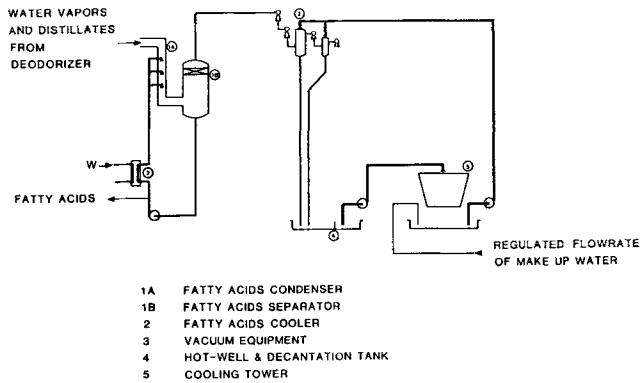

FIG. 2. Improved scrubbing system (cooling water recycled through cooling tower).

oils. Most of the water laden with various types of fatty constituents is kept in circulation.

However, part of the water must be discharged to waste to avoid increase in the minerals of the recirculated water and to avoid excessive concentration of pollutants from the deodorizing process.

Make-up water is thus introduced in the closed circuit, partly as fresh water and partly by condensation of the water vapor of the process and the steam injected in the boosters of the vacuum equipment. (See Fig. 1).

The amount of organic constituents contained in the wastewater drained from such a system depends, of course, on the efficiency of the condensing section.

Generally, for a conventional condensing system as in Figure 1, the wastewater discharged contains more than 500 ppm of fatty matter (fat, oil and grease [FOG]) after flowing through a gravity-settling tank without addition of flocculents. However, if condensation of fatty acids and other distilled constituents is efficient enough, the wastewater laden with only traces of fatty material may be totally recirculated and effluent from the plant will be minimized. (See Fig. 2).

By means of a decantation tank, traces of insoluble organic material which float to the surface are periodically removed by skimming. The recirculated water may thus contain 80 ppm to a maximum of 100 ppm FOG.

If all cooling water needed is directly available from a river or a canal, then no cooling tower is required and none need be installed. However, the water directly pumped from a canal or a river to the barometric condensers can only be drained back at the same spot if its composition is in accordance with the local authorities' environmental regulations. The fatty acids condensation system used in this case must be most efficient to ensure that the effluent cooling water meets the official pollution standards. (See Fig. 3).

The efficient condensation of fatty acids will, of course, become imperative when the deodorizer is also used for physical refining or when products containing short chain length fatty acids are processed. Our experience shows that it is possible to capture nearly all volatile oil-soluble constituents from the water vapor by combined condensation and absorption.

Figure 4 shows the basic flowsheet of the De Smet MTD Deodorizing System with a fatty acids condensation system. It shows the preliminary section which ensures intimate contact between vapor leaving the deodorizer and the cooled fatty acids in continuous circulation.

During the first contact, condensation is achieved in optimum conditions, namely: (a) The recirculated fatty acids are cooled down to a temperature of only 2-3 C (or about 3-5 F) above their solidification point. The temperature

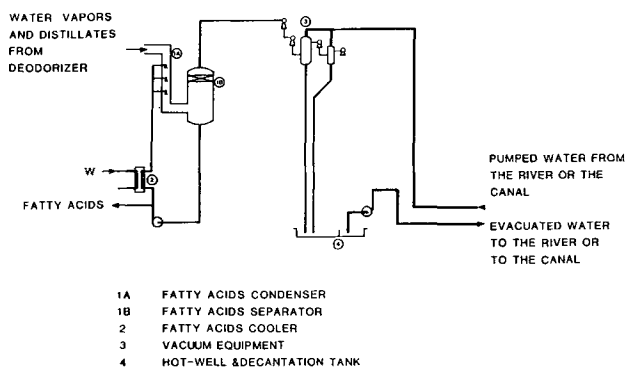

FIG. 3. Improved scrubbing system (using fresh cooling water).

control has a precision of ± 0.5 C (1F) (b) Fatty acids are sprayed at a predetermined flowrate and in the form of droplets of optimum size. (c) Efficient separation of liquid fatty acid droplets is achieved in a separator, in which the droplets are collected.

The water vapors, still superheated after this partial condensation containing only traces of fatty constituents, pass to the vacuum equipment. With the system described above, the vapor leaving the deodorizer is thoroughly purified and the circulating water of the barometric condenser is kept clean enough to avoid any fouling of the cooling tower. However, if air pollution caused by the cooling tower is to be avoided, the system of Figure 5 can be practised. In Figure 5, the wastewater circulated in closed circuit through the barometric condenser and is cooled down by means of clean water circulating in closed circuit over the cooling tower. The heat exchange between wastewater and clean water is then achieved in a plate heat exfhanger. In the case explained above, as well as in the case shown in Figure 3, a second fatty acids condensation would be necessary to avoid polluted effluents. The purpose of this second condensation is to capture volatile material and all fatty material that escaped the first condensation.

For this purpose, a second fatty acids condenser is used operating according to the principle of the first one. However, the condensing fluid sprayed in this second fatty acid condenser is a concentrated solution of calcium chloride. (See Fig. 6).

Owing to the low absolute pressure of about 3 torr maintained at the suction side of the vacuum booster, the brine temperature stabilizes at saturation temperature of -5 C (23 F) by evaporation of a certain amount of water. This temperature of -5 C (23 F) is kept constant by thermal self-regulation of the system.

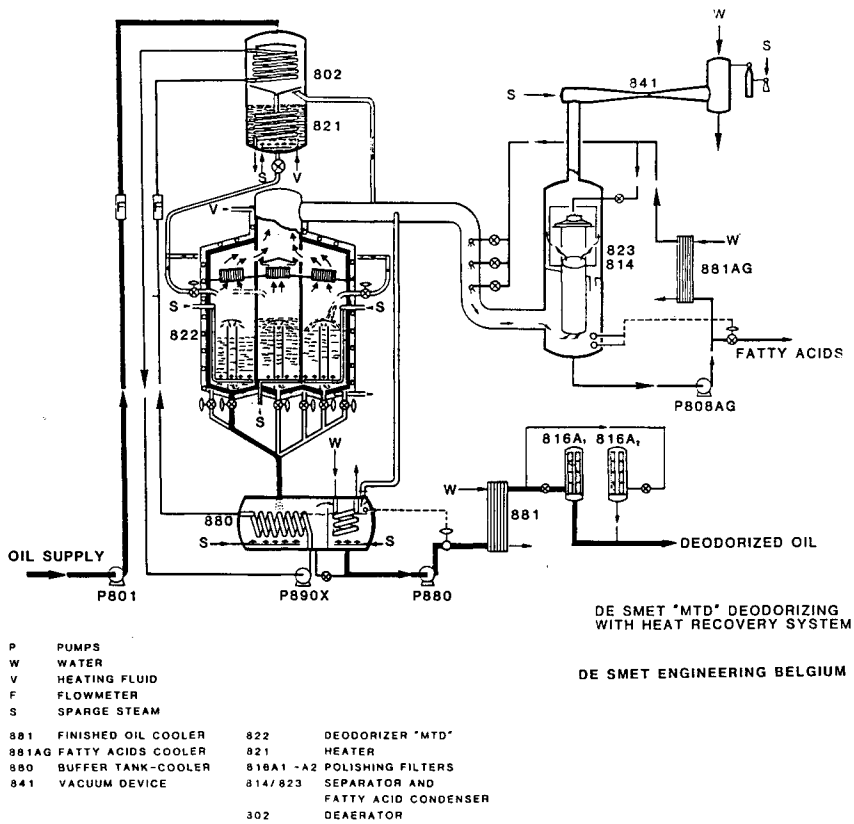

FIG. 4. Basic diagram of a deodorizing system with improved scrubbing.

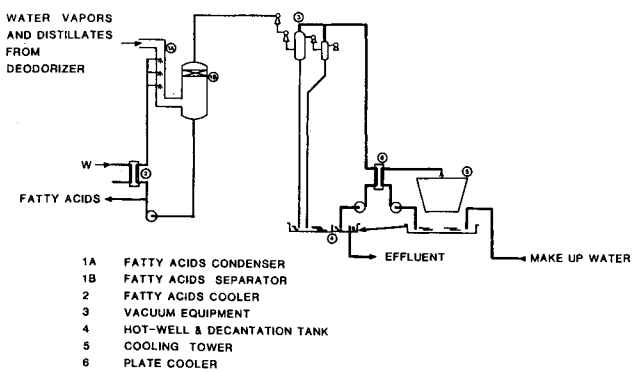

FIG. 5. Scrubbing system using cooling water recycled through plate cooler.

By adding to the brine a maximum of 0.8 kg water (1.75 lb) per ton of oil processed, sufficient cooling of the brine-vapor mixture is obtained by evaporation of this water. The additional water is evaporated and removed by the vacuum equipment. The required motive steam for the boosters to maintain 3 torr for this system compared to a conventional one would be about 5 kg (11 lb) of steam per ton of oil processed. In this way it is possible to cool the remaining volatile organics coming from the first condensation step to a temperature of about -5 C (23 F). Under this cooling effect and by spraying the brine, practically all fatty matter is removed from the carrying water vapor by combined condensation and absorption, before it reaches the booster and barometric condenser.

The fatty acids and other volatiles are thus condensed and removed by the cold brine spray. They are separated in a settling tank and then sent to a melting receiver. (See Fig. 6).

The residual pollutants finally reaching the barometric

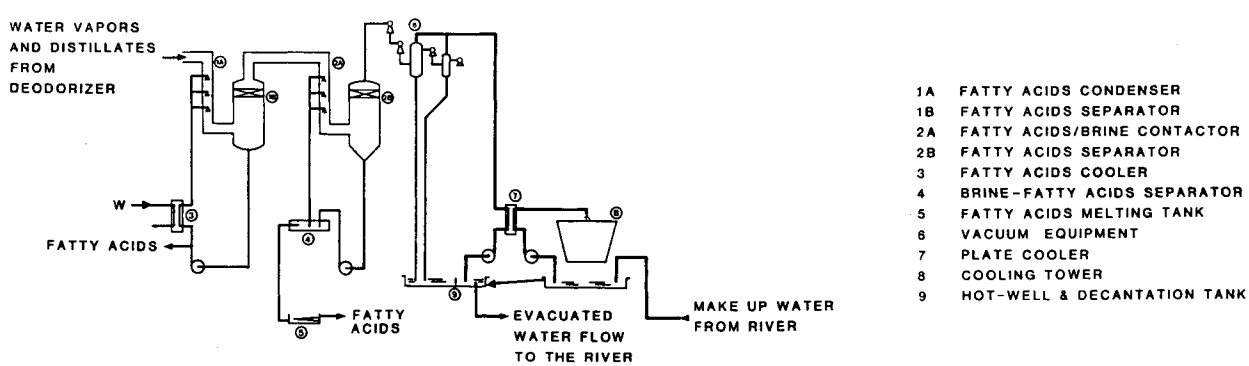

FIG. 6. Double-stage scrubbing using brine (cooling water recycled through plate cooler).

condenser are minimal. By continuous addition of a certain quantity of make-up water to the system, a corresponding amount of water is removed. This water, however, meets the most demanding standards and may consequently be drained directly to the river.

The standards imposed by most European countries for cooling water that may be drained into the rivers are given below. You will note that these standards are fairly similar to those prevailing in North America: (a) pH between 6.5 and 8.5; (b) dissolved oxygen content of at least 4 mg per litre; (c) temperature may not exceed 30 C (86 F); (d) SS (suspended solids) 30 ppm higher than the SS of influent; (e) BOD_5 (biological oxygen demand over 5 days) not exceeding 30 mg/L and COD (chemical oxygen demand) not exceeding 60 mg/L.

The first four conditions are easily met; the fifth depends directly on the fatty content of the water. The wastewater drained from a plant equipped with the double condensation system described above contains a maximum of 8 ppm of fatty matter which corresponds to less than the COD standard of 60 mg/L allowed for wastewater.

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Use of Unsaponifiable Matter for Detection of Ghee Adulteration with Other Fats

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ABSTRACT

Gas liquid chromatography (GLC) was used for the detection of lard and margarine added to buffalo and cow ghee. The chromatograms of the unsaponifiable matter could be divided into two parts representing hydrocarbons and sterols. Hydrocarbons were fractionated by GLC into 3-6 different compounds depending on the lipid origin. The sterols were cholesterol and β-sitosterol. The content of cholesterol in lipid samples was in the following decreasing order: cow > buffalo > lard > margarine. With β-sitosterol, the concentration order was: margarine > buffalo > cow > lard. The ratios of total hydrocarbons to total sterols in the unsaponifiable matter for margarine and lard were the most different for the various lipids. Adulteration of cow and buffalo ghee with various levels of lard or margarine caused significant changes in the unsaponifiable compounds. It is possible to determine the extent of admixture of lard or margarine to either cow or buffalo ghee by applying a simple regression equation for each unsaponifiable component. Hence, an examination of unsaponifiable matter appears to provide a rapid and simple laboratory method for the detection of ghee adulteration.

INTRODUCTION

There is a growing need for thorough and reliable information on the nutrient composition of all human foods. Sources of dietary fat have been changing continuously during the past two decades. Consumption of vegetable oils has risen and there has been a shift from butter to margarine and an increase in the use of solid fat for cooking. Owing to the high price of butter, unethical suppliers adulterate butter with other lipids which are similar in structure and less expensive. Various methods have been proposed for detecting the presence of foreign fats in dairy products. The differences in the melting diagrams and crystallization patterns of various lipids, as determined by differential thermal analysis, provide a basis for the determination of adulteration in cow or buffalo ghee (1). Such adulteration causes a significant change in the concentrations of certain fatty acids (2,3,4). Adulteration can be detected by the changed ratios of some fatty acids in the lipid extracts (4,5). The detection of adulteration of oils and fats by sterol analysis have been reported for: vegetable fats in milk fat (6), margarine in butter (7), other vegetable oils in olive oil (8) and animal fats in vegetable fats and oils (9).

Procedures for isolating and separating sterols from butter and margarine by Florisil column or thin layer chromatography (TLC) followed by gas chromatography (GLC) of the sterol fraction has been used to characterize lipid adulteration with plant fats (7,10). The present paper describes the examination of unsaponifiable components directly by gas liquid chromatography (GLC) without use of other preliminary chromatographic methods. This approach permits examination of both hydrocarbons and sterols for detecting the presence of lard or margarine in cow or buffalo ghee.

MATERIALS AND METHODS

Sources of Samples

Pure cow and buffalo ghee were obtained from the Food Science and Technology Department, Dairy Science Division, Faculty of Agriculture, Cairo University. Margarine and crude lard were purchased from the Abu Zaabal Company and the local market, respectively. The dissected lard was heated at 70 C and the melted fat was filtered while warm through Whatman no. 1 filter paper to obtain tissue-free and water-free lard lipids. These lipid samples can be considered as an authentic materials. Mixtures were prepared containing 5, 10, 15, 20, 25 and 30% (w/w) of margarine or lard in cow or buffalo ghee.

Sources of Authentic Hydrocarbons and Sterols

A set of hydrocarbons (*n*-eicosane, *n*-docosane, squalene, *n*-triacontane and *n*-dotriacontane) and sterols (cholesterol, campesterol, brassicasterol, stigmasterol, β-sitosterol, stigmasterol and fucosterol) was purchased from Sigma Chemical Company. The purity of these compounds was checked by GLC; each compound gave one peak. The relationship between log retention times of hydrocarbons and their number of carbon atoms was used to characterize unknown hydrocarbons (*n*-hencosane, *n*-tricosane, *n*-tetracosane,

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