practically all condensed. The condensate and remaining vapors are picked up by the Direct Acting Vacuum Pump “N” and pumped into the Atmospheric Condenser “O” where condensation is completed. The condensate flows off through the Water Separator “P,” the solvent going to Tank “J” and the water to the sewer.

The partially stripped fat-solvent from the Preliminary Still “K” flows into the Still “L” where the remainder of the solvent is removed by blowing with live steam. Both Stills “K” and “L” and Condenser “M” operate at about 24-26 in. vacuum, depending upon the temperature of the available condensing water.

The tanks are all of steel, welded construction. All Pumps are Direct Steam Driven, either Simplex or Duplex. The Condensers are made up of cast iron sections of the type used in the petroleum industry.

All Electric Motors and Starters are located outside of the building, using totally enclosed motors with the shafts passing through stuffing boxes in the walls. All movable parts are grounded. Shovels and scrapers used in handling the spent and extracted earth are made of bronze or aluminum to avoid the possibility of sparks.

The building is of steel and tile construction, with large windows, and special attention paid to ventilation. Scuppers at the floor level are provided with fixed louver which cannot be closed. Lights and light switches are of the approved type, the lamps being enclosed in heavy vapor-proof globes.

The equipment will handle one and one-half tons at a charge and two runs can easily be made in twenty-four hours. 1,200 gallons of Skellysolve “B,” boiling point 146-156 deg., are used for each wash. The extracted earth will average about 3.0 per cent fat on a dry basis. The color of the extracted oil will, of course, vary with the kind of oil on which the earth is used. In this plant, where corn, cottonseed, soya bean and coconut oil are being handled, the color of the extracted oils has been as dark as 18-R—35-Y and as light at 6-R—20-Y. The free fatty acid content has varied from 1.00% to 2.50%.

Extraction of spent earth from Filter Presses which have been blown with steam only gives the best results. One extraction of spent earth, which had been used for bleaching cottonseed oil and which had been blown in the Press with air, gave a dark, viscous oil with an iodine number of 84.6.

The operating cost in this plant is about $45.00 per day which includes labor, power, steam, water, solvent loss, and supplies. This makes a cost of $15.00 per ton of spent earth handled.

**Fat Recovery By Solvent Extraction From Animal By-products**

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**Abstract**

It is shown that solvent extraction, although using an inflammable solvent can be made safe. Operating difficulties are discussed, including corrosion caused by decomposition products of animal matter. Costs and returns are shown to demonstrate the profits available.

The subject of solvent extraction of fat from animal by-products has hardly been touched in literature. Though solvent extraction has been used for many years by laboratories for the determination of the amount of oil or fat in many classes of material including animal by-products such as tankage, meat scraps and so forth, its development into an industrial enterprise has been markedly slow.

A study made of the material produced by fifty rendering plants in the state of Ohio during the year 1936 showed an average fat content of 11.44%. With this as an average, the production of one-quarter of a million tons of this material represents a loss of fat economically available, of $2,600,000.

The rendering industry had the opinions, based on a few old attempts at solvent extraction, that the extracted meal would contain an odor of solvent and the extracted fat show darkening of color due to the use of high temperatures in trying to remove the final traces of solvent. With properly designed equipment and suitable choice of solvent, these opinions are false. Therefore the development of safe, satisfactory and profitable extraction plants has been handicapped.

The safety of the plant, mentioned as the first point, is probably thought of first when solvent extraction is considered.
cultures or unusual costs. The most
the underwriters, and offer no diffi-
tion plant are very well outlined by
therefore, safety is the first problem
and yet a simple one. The follow-
sers and the application of a little
ing of several precautionary meas-
practical and economical, naphtha
extraction of fats and oils, though
tha or any other inflammable solv-
inal material before extraction.
according to the degree of decomposition
in measurable quantities.
Perhaps it is not possible to state
products are formed but nevertheless a very
plausible line of reasoning can be
followed that yields the same prod-
utes. To start off with, protein can
hydrolyze to yield amino acids
which might be decarboxylated by
enzymes, bacteria or putrefaction,
to yield a series of amines. These
amines having small enough mole-
cules are very volatile and have a corre-
sive action similar to Ammonia. As
for the Ammonia, under the condi-
tions of decomposition and during
cooking it might be split off at any
time. The presence of Acetic Acid
and the others can best be traced
back to the starches and sugars pres-
ent in the animal’s body. The
starches could be hydrolyzed to
sugars and bacterial action fer-
ment to a series of acids of which
Acetic, Caproic and Valeric would be
the most volatile, particularly in
the presence of steam. Little could
happen to the fats as far as volatile
decomposition products are con-
cerned. The fats hydrolyze to some
extent, liberating glycine and
yielding fatty acids. These acids
are chiefly Oleic and Stearic Acid
and are not volatile under the con-
ditions present. Any parts of the
equipment that might come into
contact with the above decomposi-
tion vapors must be constructed with
the corrosive action in mind.

In the operation of the plant, ex-
tracting the fat from the rendered
material, only one problem of any
import is encountered, and this will
occur whether the material being
extracted is from dead stock, pack-
ing house waste or butcher shop
scraps. This problem is the pres-
ence of small particles of protein
material known as “fines,” in the
naphtha-fat solution being drawn
out of the extractor. If this solu-
tion is distilled as is, the presence
of a large amount of these fines
might cause slight darkening of the
fat and will cause a high insoluble
matter content that will be difficult
to remove from the fat.

This problem of “fines,” at its worst,
does not affect the feasibil-
ity of extraction but is a problem
that must be faced. The fines
have high enough gravity to settle
out of the naphtha solution but the
presence of lime soaps from the
bones, being colloiddly soluble in
naphtha, aids the suspension of
these fines and inhibits their set-
tling to a marked extent, unless
the material being extracted has
been allowed to remain 10 per cent
to 12 per cent moisture. With 10
per cent to 12 per cent moisture
in the material, the fines are suffi-
ciently wetted out to cause settling.
In other methods of fat recovery, it is
necessary to cook down to from 5
per cent to 7 per cent moisture and
it is in the extraction of these ma-
terials, from which additional fat
can be economically recovered, that
the trouble with fines is experienced.
The simplest answer is to have
separate tanks within the closed sys-
tem, where the solution of fat can
be allowed to settle for at least 8
hours. The bulk of the fines will
have settled out by this time and
can be drawn from the bottom of
the tanks back into the system and
recovered, though the solution being
drawn into the still may have ap-
plicable amounts of this material
still in suspension. The fines, when
drawn from the still, must be clari-
ified in any of the usual ways, if
the percentage of fines is too high
to enable the sale of low MIU fats.
This settling method, though not
directed at the source of the trou-
bles, remains the simplest to date.

Centrifuging is not satisfactory
because of the difficulty of avoiding
vapor losses.

Chemically there are two methods
that are satisfactory. The first,
a caustic treatment, is not entirely
dependable because of the chemi-
cal control necessary. If to the
naphtha-fat solution a solution of
sodium hydroxide is added in
amounts just sufficient to neutralize
about 40 per cent of the fatty acids
present, the fines will settle quickly.
This is probably due to a wetting
out action.

The second chemical method off-
ers one difficulty in that the addi-
tion of some fairly expensive equip-
ment is necessary. Methyl Alco-
hol is soluble to some extent in