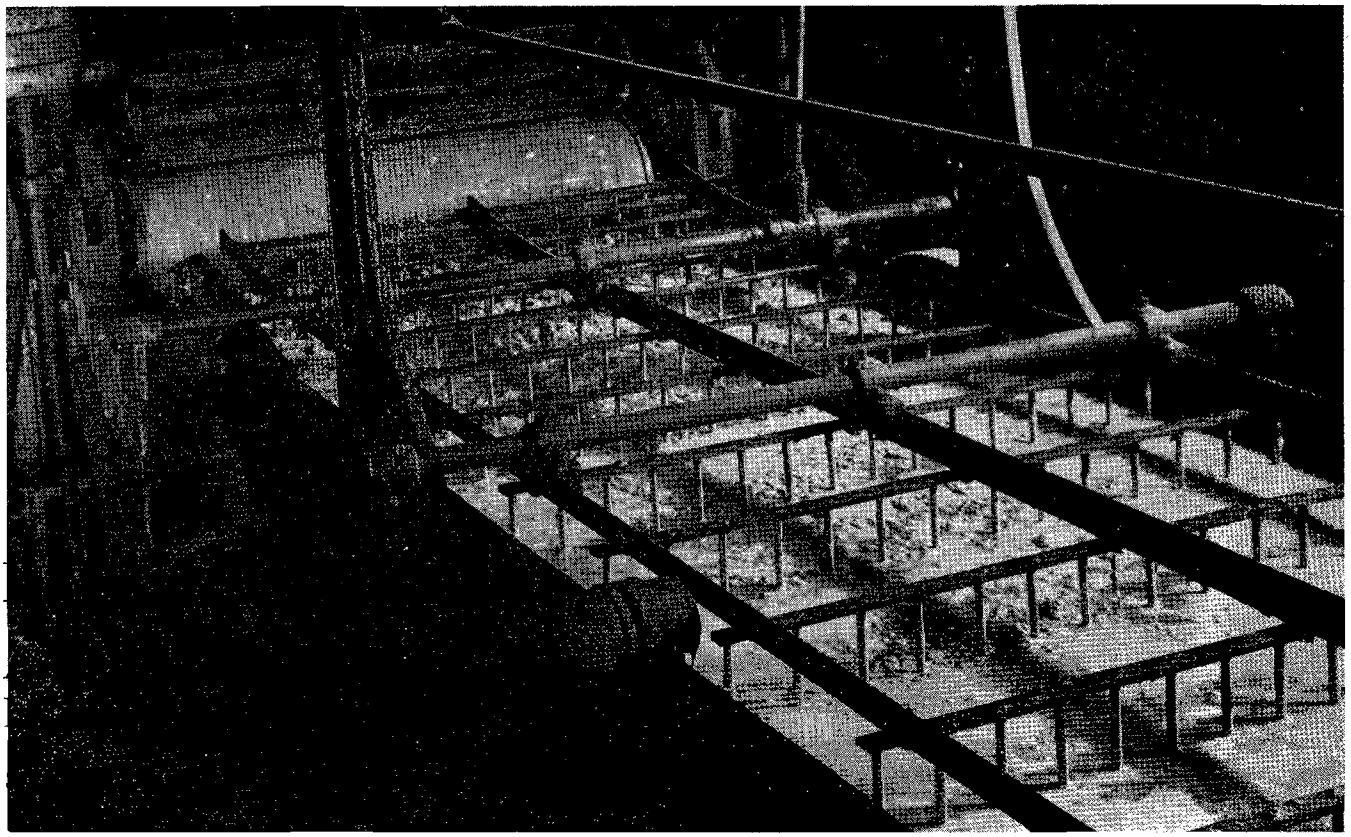

THERE PROBABLY is no other raw material in use today that is more misunderstood than Woolgrease. When one considers that this product has been in constant use by a great many industries for over fifty years, this becomes a rather startling fact. Even its name is a misnomer. Woolgrease (sometimes called Woolfat) is a wax rather than a fat since it contains no ester of glycerol. Undoubtedly, the relatively small size of the Industry, estimated at approximately $5,000,000.00 annually and the extreme competition that exists among the nine refiners in the U. S., has contributed to this fact. As a result of this competitive spirit, it is virtually impossible to standardize on nomenclature and specifications. Therefore, it becomes advisable that we start at the source, the Wool Scourer or more specifically the wash waters at the Wool Scouring Mill.

Woolgrease originates in the sebaceous glands of sheep and is excreted through its hair follicles adhering to the fiber (wool) to protect the animal against the elements.

Woolgrease is an ester composed of high fatty acids with higher fatty alcohols, some free fatty acids, various impurities from chemicals used in scouring the wool and recovering the Woolgrease. The ester would split on the average of 52% fatty acids and 48% unsaponifiable. According to Weitkamp (Weitkamp, A. W., J. Am. Chem. Soc. *67*, 447 (1945), the acidic constituents of woolgrease can be divided into four groups. The first group, even normal series consisting of the acids from C_{10} to C_{26}, the second group consists of two even acids in the alpha hydroxy series, the third group consists of ten even acids from C_{10} to C_{28} in the iso series and the fourth group consists of eleven odd acids from C_9 to C_{27} and C_{31} in the anteiso series. In addition, Weitkamp reported he found all the fatty acids to be saturated and the percentage of each acid present was extremely small, the highest concentration of any one acid is 7%. This work by Weitkamp is the most complete study ever reported on the acid fraction of the woolgrease ester. Unfortunately, no such one complete work exists on the alcohol fraction. However, it is known by the works of many individuals, to consist of: sterols, cholesterol (13%–17%), dihydrocholesterol, triterpene alcohols, aliphatic alcohols and esters.

Currently in the U. S. all but one wool scourer utilizes non-ionic detergents. At one time solvents and soap and soda were prevalent but with the advance of science these systems have become obsolete. It might be well to point out here, that woolgrease is only recovered from apparel wool, wool finer than quality 40s. Generally speaking, raw wool will contain between 5 and 30% woolgrease depending on the grade of wool scoured. In general the finer the grade, the higher the percentage of woolgrease.

Wool scouring (washing) equipment is designed primarily to remove all impurities from the wool, but unlike home washing machines, without too much agitation which along with the cleaning agent would cause felting (splitting of the woolen fibers) and reduce yields. This equipment, pictured in part on the cover and above, is called a scouring train. It consists of a duster, a series of bowls, approximately 36 in. deep, width and length vary, holding approximately 2,000 gallons of water and a drier. The raw wool is fed from a sorter into the duster, which removes some of the dry dirt and extraneous matter. Automatic feeds convey the raw wool to the first bowl where mechanical rakes propell the wool from one bowl to the next. As the raw wool moves from bowl to bowl, it is squeezed through rollers to remove most of the dirty detergent solution before entering the next cleaner bowl. The false bottom, in each bowl, consisting of perforated stainless steel plates set about one foot below the level of the detergent solution, serves two purposes:

1) Prevents the raw wool from sinking too deep, and

2) Enables heavy sediment to settle through into hopper-type sumps on the bottom from where it can be discharged.

The length of the train will depend on the type of Mill doing the scouring. Most scouring trains in use today contain four or five bowls, however, they can and do run to seven bowls. Beyond the third one, they are used for rinsing, bleaching and bluing. Usually however, after the fourth bowl the now washed and rinsed raw wool passes into the drier where it is dried to a pre-determined moisture content for additional processing.

The first bowl in a scouring train contains clean warm water with a pH of 9 in which the water soluble suint salts and extraneous matter is soluble, the heavier dirt particles settle out. The second and third bowls contain the detergent solution and it is here that the woolgrease is removed from the raw wool. The temperature of the second and third bowls is maintained at approximately 49C, slightly above the melting point of the woolgrease (36–42C).

Two methods are used in recovering woolgrease, one is mechanical employing a centrifuge and the other is chemical, requiring an adjustment in the pH of the detergent

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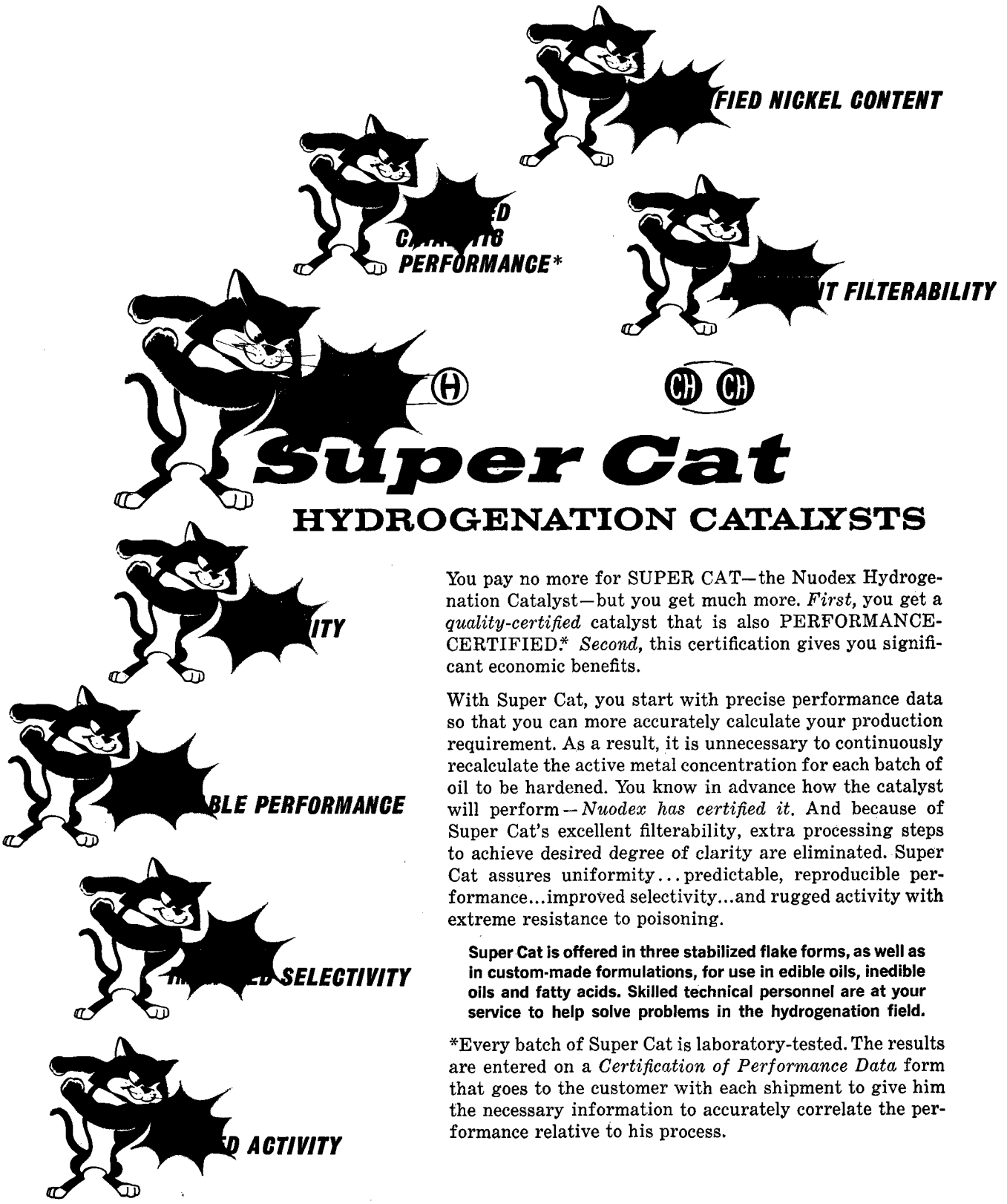

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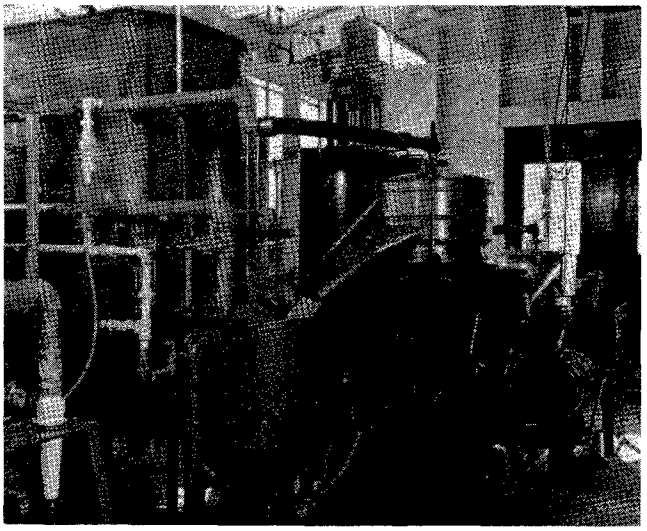

A typical primary grease recovery centrifuge installation.

emulsion before treating with sulfuric acid by which the woolgrease and sludge are settled out and later separated by filtering under slight pressure. This woolgrease is known as "Acid Cracked Degras".

Woolgrease recovered by the mechanical method is called Centrifuge Woolgrease, although it has and is being referred to as Neutral Woolgrease. At top efficiency, this method will only recover approximately 40% of the total woolgrease present. In a continuous or closed system the centrifuge machines can be connected into the scouring train at the second bowl, where the woolgrease concentration is the highest or the second and third bowl's contents can be pumped into a storage tank and from there run through the centrifuge. The centrifuge acting very much like a cream separator, separates the woolgrease from the water and also removes the suspended solids. The grease recovered in this method however is of good quality and is used almost exclusively in the production of U.S.P. lanolin. A typical analysis of woolgrease produced in this manner would be as follows:

Moisture content	1–3%
Melting point	35–42C
FFA	1–5%
Color (ASTM)	3–4
Sap. No.	Approx 100
Ash	0.2%

In converting centrifuge woolgrease to lanolin, the refiner first washes the grease, neutralizes the excess free fatty acids by saponification and bleaches. The centrifuge woolgrease is now anhydrous lanolin U.S.P.—specifications of which follows:

Color and Description	Brownish yellow, tenacious, unctuous mass.
Solubility	Insoluble in water, mixes without separation with about twice its weight of water—sparingly soluble in cold alcohol, more soluble in hot alcohol and freely soluble in ether and in chloroform.
Melting Point (USP)	36–42C
Moisture (USP)	0.5% max
Ash (USP)	0.1% max
FFA (USP)	0.564% max (as oleic)
Iodine value (I.V.) (USP)	18–36

Additional specifications including free alkali, chloride, water soluble acids or alkalies, ammonia, glycerin, water-soluble oxidizable substances and petroleum are included but rarely encountered.

All refiners offer more than one grade of U.S.P. lanolin. The differences are restricted to color and odor; the lighter the color and lower the odor, the higher the quality. Each lanolin refiner jealously guards his manufacturing technique in accomplishing these various qualities. U.S.P. lanolin is used extensively by the cosmetic, pharmaceutical, adhesive tape, printing ink and soap industries.

The lanolin refiner can also use Acid Cracked Degras in producing U.S.P. lanolin or in the production of what is called technical lanolin and neutral woolgrease. His refining process differs only slightly in that the end product has different specifications as follows:

	Technical Lanolin	Neutral Woolgrease
Spec. Gravity $\frac{20C}{20C}$	0.940–0.950	0.940–0.950
FFA (as oleic)	1.5% max	3% max
Moisture	0.1% max	0.5% max
Ash	0.1% max	0.1% max
Melting Point	36–44C	36–42C
Flash	Approx 260C	Approx 260C
Fire	Approx 276C	Approx 276C
Copper Strip @ 98.8C	5 hr min	5 hr min
Sap. No.	90–110	90–110
Saybolt Visc. @ 98.8C	Approx 170 sec	Approx 170 sec
Glycerides	None	None
I.V. (Hanus)	18–36	18–36

These analyses will vary according to customer requirements. Neutral woolgrease and technical lanolin are used by the petroleum industry, rustproofing and corrosion industries, and to a lesser extent by the soap, tape and chemical industries.

Since the end of World War II, more research and development time by more people has been spent on the woolgrease ester than the entire history of the industry prior to that time, which explains the development of such new products as lanolin oil, water and alcohol soluble lanolin, water and alcohol soluble fractions of lanolin, including wool wax alcohols (unsaponifiable), pure woolgrease fatty acids and combinations of various fractions of the ester with other chemicals to form entirely new compounds.

Not withstanding the foregoing, the most widely used industrial woolgrease product is Acid Cracked Degras. This method is far more efficient than the centrifugal process, recovering about 80% of the grease that is present, although the quality of the grease is definitely lower. A typical analysis follows:

Spec. Gravity $\frac{20C}{20C}$	0.940–0.960
FFA (as oleic)	11.0–14.0%
Moisture	0.5–1.2%
Ash	0.1% max
Melting point	36.0–44.0C
Flash point	Approx 281C
Fire point	Approx 299C
Saybolt Visc. @ 98.8C	Approx 155 sec
I.V. (hanus)	20.0–35.0
Sap. No.	100.0–116.0
Penetration @ 25C unworked	150–180 mm/10
worked	340–370 mm/10
Color ASTM (max) 10%	4.5
30%	Greater than #8

In the U. S., only one scouring mill, the Barre Woolcombining Co. Ltd. of South Barre, Mass., produces this type of grease. According to the 1958 census of manufactures report (MC 58(2)-22F) published by the Department of Commerce, the Barre Woolcombing Co. is producing approximately 40% of all the woolgrease produced in the U. S.

Acid Cracked Degras is used extensively by the following industries: petroleum, cordage, leather, tanning, rust and corrosion proofing, specialty lubricants, chemical, paint and sheep marking fluids, fur dressing, lumber and wood products.

(Continued on page 10)

Lanolin Nee Woolgrease

(Continued from page 6)

The fatty acid fraction of the woolgrease ester has, since the end of World War II received considerable attention, particularly by the petroleum grease manufacturers and rust proofing compound formulators. Two patents, 2842493–2842494, have been issued in which these fatty acids are incorporated in lithium base greases. The original woolgrease fatty acids were produced as a by-product of the production of cholesterol from woolgrease, however, as the world consumption of cholesterol diminished so did the production of woolgrease fatty acids. Fortunately the production and consumption of the unsaponifiable fraction (called wool wax alcohols) was increasing. In addition, the lanolin refiners loss (neutralization of excess FFA) in processing woolgrease to U.S.P. lanolin could be further treated and made acceptable. There are some disadvantages however to this product due to the low total fatty acid content.

Today, two types of woolgrease fatty acids are readily available and adequately fill the void created by the cutback in the production of cholesterol. Analysis of these products are given below.

	Crude Grade	Refined Grade
Moisture	0.5–1.5%	0.5–1.5%
Ash	0.0–0.15%	0.0–0.15%
FFA (as oleic)	56–58%	86–88%
Saponification value	120	180
Unsaponifiables	36–37%	1.0–3.0%
I.V.	30	19
Melting point	35C	52C
Softening point (titer)	35.5C	47C
Specific gravity–25C	0.908	0.953
Color	Dark brown	Light brown

In this article, I have attempted to present a complete picture, in digest form, of the woolgrease industry without discussing each and every facet to the point of boredom. A much deeper study of the wool and woolgrease industry was published by the Department of Commerce in their report "Woolgrease", marketing research report No. 89 and is available merely by writing for it. If you do, keep in mind that the woolen industry has suffered a tremendous contraction, approximately 60%, as a direct result of the in-roads made in wearing apparel by synthetic fibers since the end of World War II.

• *Industry Items*

CARGILL, INC., Minneapolis, Minn., recently began production of fatty nitrogen chemicals. This marked the firm's first entry into production and marketing in this field.

CHEMETRON CORP., Chicago, Ill., has acquired a fifty per cent interest in Northern Chemical Industries Inc. NCI, headquartered in Baltimore, produces ammonia, sulphuric acid, super-phosphates and other chemicals at facilities in Searsport, Maine.

• *New Members*

Active

William Barnett Guerrant, Jr., Professor of Organic Chemistry, Austin College, Sherman, Texas.

Tzolack T. Johannes, Chemist, Lever Brothers Co., Los Angeles, Calif.

Einar August Stenhagen, M.D., Professor of Research, Institute of Medical Biochemistry, University of Goteborg, Goteborg, Sweden.

Samuel Taormina, Chemist, General Services Administration, South San Francisco, Calif.