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FEED FATS QUALITY AND HANDLING CHARACTERISTICS

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There are over 3 billion pounds of feed fats purchased in the U.S. every year. Fats started to be added to feed in the 1950's. Experience since then has shown us the value of fats and how to handle them in the feed mill.

Today's presentation will first cover the types of feed fats used in feeds at levels up to 15% added fat and quality factors to consider.

FAT SOURCES

Most feed fats fall into the category of inedible tallow and grease. ***Table 1*** shows that feed usage dominates this category at over 75% since 2001.

TABLE 1
DOMESTIC USAGE OF U.S. INEDIBLE TALLOW & GREASE
Millions of Pounds

Year	Total	Soap	Fatty Acids	Feed	Lubri-cants	Other
1950	1,777	1,280 72%	250 14%	- 2%	28 12%	217
1960	1,745	732 42%	351 20%	443 25%	70 4%	151 9%
1970	2,628	616 23%	568 22%	1,140 43%	89 3%	214 8%
1982	2,894	550 19%	737 25%	1,393 48%	53 2%	161 6%
1989	3,285	397 12%	722 22%	2,013 61%	110 3%	43 1%
1992	3,050	334 11%	659 22%	1,954 64%	63 2%	38 1%
1995	3,090	264 9%	621 20%	2,070 67%	90 3%	45 1%
1996	3,374	245 7%	629 19%	2,386 71%	89 3%	35 1%
1997	3,393	245 7%	620 19%	2,401 71%	84 2%	44 1%
2001	3,657	140* 4%	578 16%	2,830 77%	80* 2%	35* 1%

Source: U.S. Dept. of Commerce, Bureau of Census M20K Report
*Estimated

TODAY'S FEED FATS

Any discussion of feed fats being used in feed today requires putting all the types of fat used into broad categories and then studying each category for quality and handling characteristics.

TABLE 2
FEED FAT CATEGORIES

1. ANIMAL FAT	- Includes rendered fats from beef or pork by-products. Can be identified as tallow if titer (hardness measurement) is 40 or higher, or as grease if titer is under 40. Lower titer indicates higher unsaturated and/or polyunsaturated levels.
2. POULTRY FAT	- Includes fats from 100% poultry offal.
3. BLENDED FEED FAT	- Includes blends of tallow, grease, poultry fat, and restaurant grease.
4. BLENDED ANIMAL & VEGETABLE FATS	- Includes blends of feed grade animal, poultry, vegetable fats and/or restaurant grease. May also include soap, chemical and other industry by-products.
5. VEGETABLE SOAPSTOCK	- Includes free fatty acids removed from oil during refining.

In ***Table 2,*** notice that restaurant grease is included in categories 3 and 4. There is a significant volume of restaurant grease blended into feed grade fats. The fat can be vegetable, animal, or animal/vegetable blends depending on the components of the cooking fat involved. In recent years most restaurant cooking oils have been hydrogenated soybean blends.

Feeding studies with poultry have shown no significant difference in feed efficiency among cooking fats before and after restaurant use. Vegetable source restaurant grease is becoming a much desired component of feed fats.

Quality standards for feed fats have been developed over the years taking into consideration each type of fat characteristics.

Before we discuss quality specifications for the five categories of fat in ***Table 2***, let us examine ***Table 3***, which lists fats and oils' industry standards for commodity tallow and grease.

TABLE 3
GENERAL FAT AND OIL INDUSTRY TRADING STANDARDS FOR TALLOW AND GREASE

	TITER Min	FFA Max	M. I. U. Basis	M. I. U. Max	FAC COLOR Max
TALLOW					
Extra Fancy	42.0	2	1		5
Fancy	40.5	4	1		7
Bleachable Fancy	40.5	4	1	2	None
Prime	40.5	1	1	2	13-11B
Edible	4.2	1	1		5
DARK TALLOW					
Special	40.5	10	1	3	19-11C
#1	40.0	15	2	4	33
#2	40.5	20	2	4	39
#3	40.0	35	2	4	None
GREASE					
Choice White	36	4	1	2	13-11B
Yellow	36	15	2	4	37

You will note that a major emphasis was placed on hardness (Titer) and color as quality factors. Feed users in the 1950's that wanted quality used these criteria along with general cleanliness of fats in determining the value for their feeds. Today these standards are used for commodity fats, both edible and inedible, purchased for pet foods and other specialized uses.

SPECIFICATIONS FOR FAT SOURCES

FEED USE

TABLE 4 contains our suggested minimum quality specifications for the categories of fat in ***TABLE 3***. Individual specifications have been developed by many feed fat users.

TABLE 4
SUGGESTED QUALITY SPECIFICATIONS FOR FEED FATS
(Revised 2003)

		ANIMAL	POULTRY	FEED GRADE ANIMAL	ANIMAL/ VEG.	VEG. SOAP STOCK
Total Fatty Acids	Min%	90	90	90	90	90
Free Fatty Acids	Max%	15	15	15	15*	50
Moisture	Max%	1	1	1	1	1.5
Impurities	Max%	0.5	0.5	0.5	0.5	1
Unsaponifiable	Max%	1	1	1	1.0	4
Total MIU	Max%	2	2	2	2	6

* When blended feed fats contain acidulated soapstock, this specification can be adjusted to allow higher FFA found in this fat. (e.g., 5 FFA per 10% added.)

1) Fats must be stabilized with an acceptable feed or food grade antioxidant added at levels recommended by the manufacturer. Fats should pass the AOM stability test at 20 hours me Peroxide and the initial peroxide test (IPV) at less than 5 me P.

2) No cottonseed soapstock or other cottonseed by-products should be included in fats for layer, breeder or broiler rations.

3) Fats must be certified that any PCB and pesticide residues are within the allowable limits established by state and/or federal agencies.

4) Fats for poultry rations should be certified as being negative for the Chick Edema factor as measured by the Modified Libermann-Burchard test.

5) Fats shall not contain more than trace levels of any minerals, heavy metals or other contaminants.

6) The supplier should make every effort to provide a uniform fat structure in each delivery. A specification for minimum and/or maximum Iodine Values can be established for the type of fat purchased. Monitoring IV's can determine if the product's fat structure is uniform.

TABLE 5 was developed as a guide to the types and frequency of analysis that we recommend be used to monitor feed fats. These criteria vary by category of fat since certain types of fat are more susceptible to variations in certain analysis. Naturally, if you are experiencing field problems that you feel are related to poor quality fats, or if particular suppliers exhibit continuing quality deficiencies, then frequency of laboratory tests needs to be accelerated.

TABLE 5
QUALITY CONTROL CHART
(Revised 2003)

Type of Fat
1) Animal fat – Tallow/Grease
2) Poultry Fat
3) Blended Feed Grade Animal Fat
4) Blended Animal & Vegetable Fats
5) Vegetable Soapstocks

Frequency Code
A - Every Sample
B – 1 of 2
C – 1 of 5
D – Every Sample – Composite of 3
E – Check each Supplier Periodically

		Type of Fat				
Analysis	**ACC Method**	**1**	**2**	**3**	**4**	**5**
Moisture	Ca 2A-45	A	A	A	A	A
Impurities	Ca 3-46	A	A	A	A	A
Unsaponifiable	TKLa-64T	C	C	A	A	A
Total Fatty Acid	G3-53	C	C	C	C	A
Free Fatty Acid	CA 52-40	A	A	A	A	A
PCB/ Pesticides		D	D	D	D	D
Stability						
Initial Peroxide	Cd 8-53	A	A	A	A	A
AOM Test	Cd 12-57	A	A	A	A	A
Gossypol*	Halphen Test	E	E	E	E	E
Iodine Value	Cd 1-25	A	A	A	A	A
Fat Structure	Ce 1-62	E	E	E	E	E

*Poultry use only

TABLE 6 lists physical properties of a typical blended feed fat with a 75-80 Iodine value. Note the effect of handling temperature on all properties shown. This information can serve as a guide for calibrating meters and other fat handling equipment.

TABLE 6
SOME PHYSICAL PROPERTIES OF FEED FATS

A. Specific Gravity, Weight and Viscosity at Various Temperatures

Temperature ° Fahrenheit	Specific Gravity	Weight per Gallon In Pounds	Viscosity Centipoises
100°F	0.899	7.49	35
120°F	0.893	7.44	24
140°F	0.866	7.39	17
160°F	0.880	7.34	13
180°F	0.872	7.27	8
200°F	0.866	7.22	8

B. Other Data Related to Fat Handling (Approximate Values)

Specific Heat	0.5 BTU/lb/°F
Thermal Conductivity	0.05 BTU/hr.ft.2°F/ft.
Melting Point	85° - 120° F
Flash Point (Closed Cup)	325° - 500° F

TABLE 7 contains typical analysis of liquid fats with an added list of estimated melting points to guide you in fat handling in your feed mills (see page 7).

TABLE 7

TYPICAL ANALYSIS – LIQUID FATS

(Revised 2003)

Fatty Acid Composition	Type of Fat	Beef Tallow	Lard	Hog Grease	Poul-try	Rest-aurant Grease	Cotton Seed	Soy-Bean	Corn	Canola	Palm
C:14 Myristic	Sat	3.0	1.5	1.5	1.5	1.9	1.0	-	-	-	1.5
C:16 Palmitic	Sat	25.0	27.0	23.0	21.0	15.0	23.0	11.5	-	-	46.0
C:16-1 Palmitoleic	Mono	2.5	3.0	3.5	6.5	1.5	1.0	-	-	-	-
C:17 Margaric	Sat	1.5	0.5	0.5	-	1.0	-	-	-	-	-
C:18 Stearic	Sat	21.5	13.5	11.0	8.0	9.0	3.0	4.0	2.5	2.0	4.0
C:18-1 Oleic	Mono	42	43.4	40.0	43.0	48.0	18.5	24.5	29.0	60.0	43.0
C:18-2 Linoleic	Poly	3	10.5	18.0	19.0	20.0	52.5	53.0	55.0	20.0	9.5
C:18-3 Linolenic	Poly	-	0.5	1.0	1.5	3.0	-	7.0	0.5	10.0	-
C:20 Arachidic	Sat	-	-	-	-	-	-	-	-	-	-
C:20-1 Eicsenoic	Mono	-	-	-	-	-	-	-	-	2.0	-
C:22 Behenic	Sat	-	-	-	-	-	-	-	-	-	-
C:22-1 Erucic	Mono	-	-	-	-	-	-	-	-	2.0	-
MELTING POINT - °F Range		90-105	75-90	70-85	65-80	65-75	40-50	30-40	30-40	35-50	90-110
IODINE VALUE		50	65	74	84	89	110	125	125	117	50
TYPE OF FAT:											
Sat = Saturated %		51	43	36	30	27	27	15	15	6	47
Mono = Monounsaturated %		45	44	43	49	49	19	24	29	64	43
Poly = Polyunsaturated %		3	11	19	20	23	52	60	6	30	10

FAT HANDLING IN THE FEED MILL

STORAGE:

Fats have been added to feeds for over 50 years and the need for heated storage tanks, heat traced conveyance lines and feed application sprayers and systems is well known. We will not try to cover these topics, but will be happy to answer your questions and provide technical information as required.

We will provide the following guidelines:

I. Typical feed fats should be stored at 120-130°F to provide a free flowing fat. Higher temperatures (up to 180°F) are desirable using pre-heating work tanks or in-line heaters when applying feed fats to dry ingredients. There is considerable savings in heating cost to hold large storage tanks at lower temperatures.

II. Fat storage tanks with cone bottoms allow fats to be heated externally with heating applied to the cone of the tank. Recirculation of the fat is desired to keep fat temperature in the tank uniform and to aid in heating the fat. Flat bottom tanks should have agitators.

III. All fat lines should be heated with heat tape or wrapped heat coils.

IV. The use of bottom loading lines is desired for fat storage tanks to minimize oxidation taking place when fats are pumped into tanks. This also tends to prevent buildup of solids in the bottom of tanks.

V. Filters should be installed on unloading lines to prevent impurities from entering storage tanks.

SAMPLING OF FATS

It is very important to take accurate representative samples of all feed fats delivered to your mill. Part of the sample should be retained with the balance sent to your laboratory for analysis. Types of analysis recommended are shown in ***Table 5*** of this presentation.

Sampling Techniques:

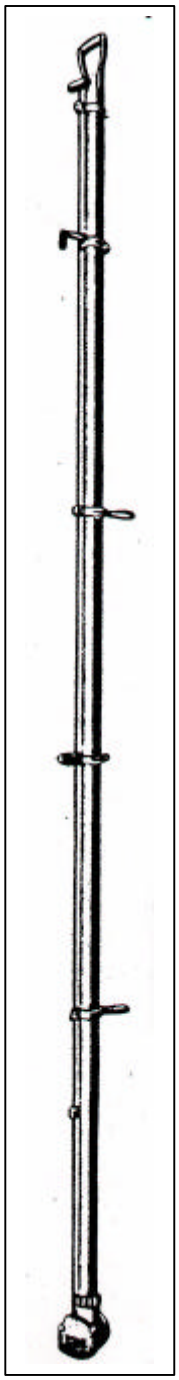
There are 3 basic ways to sample incoming fats being delivered by truck or rail:

1) **Cone samplers** (see illustration I) are long sampling tubes that can reach to the bottom of a tank after being slowly lowered from the dome of the truck or tank cars. This trier is then emptied into a sample container and thoroughly stirred before filling sample cans or jars.

ILLUSTRATION I

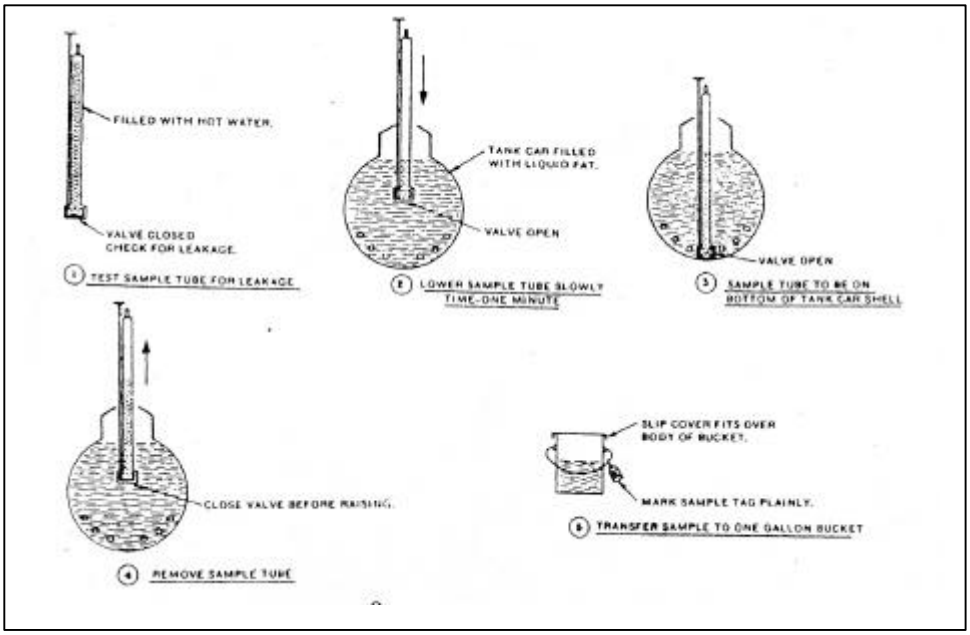
Natural Cottonseed Products Association Type No. 1 Sampler

The N.C.P.A. sampler is a two inch aluminum tube of sufficient length to take cross section of the entire depth of the tank car. The order of sampling a tank car or tank truck of liquid fat is as follows:



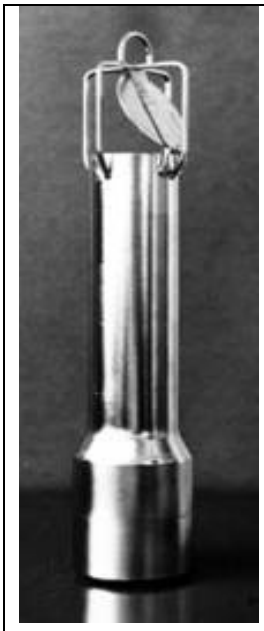
1. Test the N.C.P.A tube for leakage at least once per week. Fill the tube with hot water and hang it in an upright position for five minutes. If it leaks, it should be repaired. Be sure the tube is dry before using for samples.
2. Lower the tube slowly so that the level of the fat inside the tube and in the tank will be the same at all times. This will require at least one minute for liquid fats.
3. Close the valve after the tube reaches the bottom of the tank. It should not rest on the coil
4. Remove the tube from the tank. Be careful to maintain balance while doing this.
5. Open valve and discharge contents of tube into one gallon sample bucket. One tube full is sufficient. The sample bucket should be equipped with a moisture proof lid and should have a flat bottom. A paddle agitator is used in mixing the sample, and if the bottom is dished, the paddle will not mix the sample uniformly. Label the sample carefully at this time.
6. Mix the sample thoroughly and fill two quart jars. Each jar should be properly labeled. One may be used for analysis and the other retained.

The N.C.P.A sampler does not take the exact proportionate amount of water when free water is present in the tank. Nor does it reach the settlings that are washed to the ends of the car where they are piled up. The real solution to the problem of sampling is to make certain that only clean fat free from water and settlings is pumped into the tank.



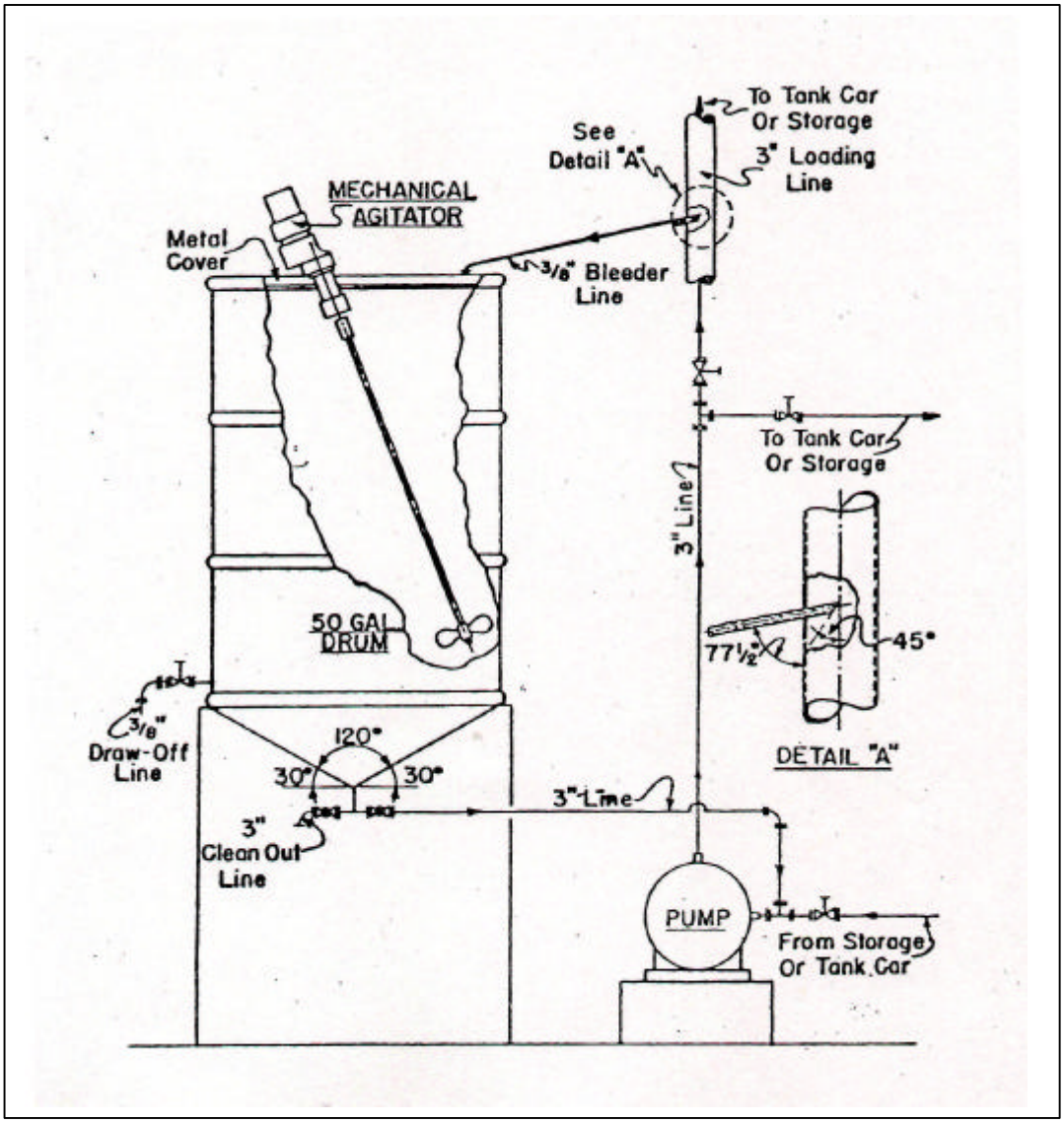
2) **Zone samplers** (see illustration II) which can be lowered into tanks to thake samples at all levels of fat. Because of the shape of tanks, several levels of sampling are desired. One bottom, two mid-levels and one top sample is the usual pattern.

ILLUSTRATION II
ZONE SAMPLERS

	**Liquid Zone Sampler** The basic plan of the zone sampler is to allow the product to pass through the sampler as it descends through the liquid. The top and bottom valves open with the pressure of the liquid against the descending sampler allowing the liquid to pass through the sampler. When the instrument is brought to a stop the valves close. Capacity 800 milliliters. Net wt. 3 lbs. Ship wt. 4 lbs. Actual dims: 15" H x 3" diameter.
	**Bacon Liquid Sampler** This popular sampler is used to obtain bottom, near bottom and average samples from tanks, tank cars and drums. Constructed of nickel plated brass, valve lifts when bottom of tank is reached. Can be manually lifted by a cord attached to the valve plunger if intermediate level samples are desired.

3) **Bleeder line samplers-Continuous flow method** (see illustration III). This is a bleeder line usually installed in a vertical section of the unloading line between the filter and the fat storage tank. It should be sized to take a given quantity of fat during the entire unloading of the tanks truck or rail car.

ILLUSTRATION III
BLEEDER LINE SAMPLER



AVAILABILITY OF SAMPLERS:

NCPA- Trier Cone Samplers – Refinery supply Co.
Tulsa, OK
(918) 836-4681

Zone Samplers – Seedburo Equipment Co.
Chicago, IL
(312)738-3700

COMMENTS:

Since feed fat is an important feed ingredient, it should receive the same quality and sampling concerns as your major ingredients (i.e. Corn, Soybean Meal). The energy levels in feed fats are important to your nutritionist and the only way to determine this level is by sampling and analyzing the fat. Please remember that at today's fat prices (13-15 cents/lb.), a 10% deficit in energy will cost you approximately $650.00 per truckload of fat.