Net Loss in Crude Cottonseed Oil Refining

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Abstract

Reasons are given for failure to arrive at a satisfactory materials balance on the crude oil refining operations, and a simple laboratory method is proposed for evaluating the refinery foots which avoids the necessity of obtaining their amount or analysis.

ACCOUNTANTS quite frequently encounter apparently anomalous results in attempting to arrive at a materials balance on Crude Cottonseed Oil refining operations. The conviction is rather firmly fixed that the sum of the recovered values should equal the "moisture and impurity free" crude charged to the process.

The fallacy in this reasoning lies in the ambiguous use of the term "Impurity." Applying the term as meaning all non-fats, the reasoning would be valid, but the meaning must be limited by a prescribed method of analysis to substances insoluble in hot kerosene. This gives a measure only for the gross impurities such as meal and dirt, but gives no measure for the oil soluble non-fats which are normal constituents of the crude oil, consisting of raffinose, pentosans, hull resins, peptones, proteoses, phospholipins, color substances, mucilaginous and albuminous substances. These substances react, more or less completely, with the alkali used for refining and are decomposed or concentrated in the "foots." Also, in evaluating the foots on their Fatty Acid content according to the official method of analysis, 41.3% of the glycerol yield would be included as non-fat.

From the same consideration, the standard accounting formula: *100% — (% moisture & impurities + 413 x Glycerol yield) = % Fatty Acid,* is not valid for crude cottonseed oil.

Further accounting difficulties are encountered by the refiner who is also a processor of his production of foots, since this material is notoriously hard to gauge, transfer, and sample accurately, consequently both the amount and value data are unreliable.

The amount of crude charged to refining and the amount of the resulting refined oil can be determined accurately and both lend themselves to accurate sampling. A valid measure of the net refining loss may be calculated from these amounts, reduced to a moisture and impurity-free basis, as defined above, together with the Total Fatty Acid values of the crude and refined oils. Such a calculation is shown in Table II.

This procedure would be rather cumbersome and opened to some criticism as to accuracy, since the result hinges on two determinations of total fatty acid on materials having a content of the determined substance close to 95%. Also, before proceeding, it would be necessary to define the term Total Fatty Acid, since the solvent, whether petroleum ether or ethyl ether, would have a bearing on the results. The author's personal preference is for the petroleum ether solvent as more nearly representing the soap recovery value, but opinion is divided on this point. Either solvent would give acceptable but not comparable accounting values.

Another much simpler method which eliminates the amount and analysis of the refinery foots, promises to give satisfactory accounting values. This involves a laboratory refining of the crude by the standard method, together with the determination of the amount and the Total Fatty Acid content of the resulting foots. The ratio of the Value in the Foots to the Direct Loss to Foots is calculated from these data and this ratio applied to the Direct Loss to Foots as found in the plant refining operations. The difference between the input and the sum of the recovered values represents the Net Loss. A typical calculation according to this method is shown in Table III.

This procedure is not strictly correct due to probable deviations between laboratory and plant direct losses, however the direct loss is but a minor factor in the calculation and the probable errors from this source would undoubtedly be much less than the combined weight and sampling errors involved in attempting a physical evaluation of the refinery production of foots.

TABLE I.
TYPICAL ANALYSES OF COTTONSEED FOOTS

Lewkowitsch[1]		Jamieson[2]	
Fatty Anhydrids	48, 50%	Neutral Oil	18.7%
Glycerol	3.98	Fatty Acids from Soap	24.0
Caustic Soda (Na_2O)	3.20	Na_2O	3.3
Foreign Organic Matter	5.90	Non-fatty Acids	8.0
Coloring Matter	2.42	Moisture	45.6
Water	36.00		

1. Lewkowitsch, "Chemical Technology and Analysis of Oils, Fats, and Waxes," 4th Ed. Vol. III, p. 341.
2. Jamieson, "Vegetable Fats and Oils," p. 183.

TABLE II.
TOTAL FATTY ACID METHOD
Composite Samples Crude and Refined, Period Ending XXX

Analysis	Crude	Refined
Moisture	0.21%	0.08%
Insoluble Impurities	0.05	0.01
Fatty Acids & Unsap. (by Pet. Ether)	93.91*	95.27*
* Basis moisture and impurity free oil.		
	M. & I. Free Oil	**Equiv. FA&U**
Crude to Refining	479,508 lbs.	450,306 lbs.
Refined Oil Recovered	422,657 lbs.	402,665 lbs.
Loss to Foots	(a) 56,851 lbs.	(b) 47,641 lbs.
Net Loss (a — b)	9,210 lbs.	

Ratio, Value in Foots/Direct Loss = 47,641/56,851 = 0.838

TABLE III.
LABORATORY REFINING METHOD
Composite Sample Crude, Period Ending XXX

Item	Amount	M. & I.	Amount M. & I. Free
Crude	500 gms.	0.26% (table II)	498.7 gms.
Refined	457.2 gms.	0.09	456.8 gms.
Foots	68.5 gms.	@ 50.95% FA&U.	34.9 gms.
Direct Loss to Foots			41.9 gms

Ratio, Value in Foots/Direct Loss = 34.9/41.9 = 0.833
Loss to Foots (a) Table II, 56,851 lbs. X 0.833 = 47,357 lbs. (b_1)
Net Loss (a — b_1) 9,494 lbs.