How Cottonseed Deteriorates Through Moisture

The Solution of This Problem Will Save Our Oil Mills Millions of Dollars Annually

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ONE of the greatest difficulties of the cotton oil industry is its dependence on the quality of the raw material; neither is there a possibility of improving the seed after it has deteriorated, nor can good oil and press cake be manufactured from an off-grade seed.

The chief cause of deterioration is excess moisture, which may have been acquired in several ways. It is only seldom that the seed becomes wet after ginning, although that might happen when it is stored in places without sufficient protection against the weather; for instance, in sheds with leaky roofs or when shipped in faulty freight cars. When the farmers hold their seed at the farm with the intention of waiting for better prices, the seed only rarely are protected sufficiently against rain. And such seed, when later bought by an oil mill, usually has a high moisture content or already is deteriorated, sometimes to such a degree as to be valueless. It happens occasionally that farmers will wet the seed before delivery to increase their weight to receive more money.

But all those cases are only exceptions and a high moisture content is generally acquired in the fields before picking. When it rains before the bolls open and the seed cotton stays wet in the field for some time the seed are damaged, even when they are dry again when they are picked and no heating takes place. The oil mills rarely receive seed that are field damaged only; because, when there is much rain at cotton picking time, the seed cotton usually is still wet when picked and become more damaged during storage or transit.

Every year oil mills pay a huge toll to moisture; first in the way of field damaged seed, and later in seed that is damaged by storage. Because no convenient method is known for the mills to determine readily whether they receive prime seed or field damaged seed, the chance of their losing is heavy. And because field damaged seed usually is prevalent over wide areas, the risk to the mills is tremendous. Seed damaged by storage presents a similar problem: Although the damage is clearly preventable no one has yet evolved a wholly satisfactory method of avoiding it.

Here is a big problem for some one to solve.—The Editor.

The difference between field damaged seed and storage damaged seed is that the field damaged

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seed still has the prime color while storage damaged seed is discolored. Both kinds of seed yield oil higher in free fatty acids than prime seed, although field damaged seed will never yield as bad an oil as will some storage damaged seed. This works to a disadvantage to the oil mills, because at present there is no way by which the mills can conveniently determine whether they receive prime seed or field damaged seed. According to the rules of the Interstate Cotton Seed Crushers Association the buyer can only deduct from the sales price for discolored seed and excess moisture, and not for high acidity even if he should know of it at the time of sale. This will result in great losses to the oil mills because conditions causing field damaged seed will extend over large areas and the oil mills will find out when too late that they paid for prime seed and received inferior seed. I have seen seasons where oil mills had to pay a claim for every car of oil shipped on account of excess refining loss although, as determined by cutting, only prime seed had been bought and crushed. Quite often the superintendent is then blamed for manufacturing bad oil from good seed. The cake will be of prime color but the acidity of the oil may run considerable over 1.50 per cent F. F. A. The oil usually is not hard to refine but the refining loss will be higher than the permitted 9 per cent. An analysis would of course reveal their real quality but such a determination is only rarely made; because, as far as I know, no method is known which would quickly determine the real quality of cottonseed. Storage damaged seed are more easily detected, because when seed heat they become discolored and the discoloration increases with the degree of damage although it is impossible to judge accurately by the color the grade of oil that can be obtained.

When damp seed are stored the temperature of the pile rises rapidly and can increase 50 to 60 degrees in a few days. There is no case known where the temperature rose to such a degree as to cause the seed to burst into flames spontaneously; but a temperature of 175 degrees has been observed by me in a car of seed received at the plant and the temperature may have even been higher before the car reached us.

The danger line for moisture is around ten per cent, but conditions will determine whether seed with that moisture will heat. When put into large piles as soon as ginned, seed will heat easier than seed that have been kept cool for several weeks and then put into piles, although the moisture content might be the same in both cases. Warm and damp weather continuing for several days may cause heating in a pile of seed which otherwise may have remained cool. A pile of seed which had remained cool for quite some time will start heating if a few tons of seed of high moisture content placed alongside of it will start heating. The same may happen if on account of a leak in the roof overhead a small portion of the pile will become sufficiently wet as to start heating; then the whole pile will become infected and heat up. A steam pipe placed too near the pile may start local heating which if not stopped in time will spread to the whole pile. Seed containing much impurities like trash, bolls, and mashed seeds will start heating with a lower moisture content than clean seed. These instances are meant for seed whose moisture content is within 10 and

12 per cent. Seed with less than 10 per cent will rarely heat and seed with more than 12 per cent moisture have to be kept cool to prevent heating.

Considering that the value of heated seed may be only half or even less than that of prime seed, depending on the degree of deterioration every oil mill will try to prevent seed from getting hot and there are several ways to obtain this result but in bad years the seed are received by the oil mills already in bad condition or the moisture content is so high that the oil mills are powerless in stopping the deterioration.

The best and safest way would be to dry the seed before storing and several seed dryers have been installed. The drying is done by blowing hot air through thin layers of seed and cooling the seed by means of cold air blasts before storing. Although such an installation is effective the investment is very high, because the capacity has to be great enough for the peak load lasting only a few weeks. And as bad seasons are fortunately rare the dryers may be idle and may not be needed for several seasons. Another disadvantage is that the lint becomes brittle on account of the high temperature during drying and the manufactured lint will be of lower grade and value. The dryer has to be watched very carefully or its value is decreased proportionately. The seed can also be dried by spreading them in thin layers and turning them over occasionally by forks. This method can only be used when the seed sheds are nearly empty as at the beginning of the season, because very much space is required. Should the weather be damp a long time will be required for this drying.

If a pile of seed begins to heat there are two ways to cool off the seed. The one way is to move the whole pile of seed by feeding into horizontal and vertical conveyors and making a new pile. The further the seed is made to travel the better, because besides cooling the seed some moisture may be lost. Another way of keeping a pile of seed cool is by blowing air through it by means of a blower. The seed bins will have to be equipped beforehand for this eventuality with air conduits permitting the air to pass uniformly through the seed. Only a few inches of air pressure are required and a six-foot blower can take care of several thousand tons of seed. It is not necessary to blow air through the seed continuously because the temperature will drop quickly as soon as the air is turned on. This method suffers from the disadvantage that the air will carry the moisture from the bottom layers to the seed at the top and there the moisture may condense or be absorbed by the seed. If the ventilation were kept up for a long time it would eventually dry out the whole pile, but rarely such great volumes of air are blown through and the humidity is usually high during the fall months.

Several years ago experiments were made to prevent heating by the addition of chemicals to the seed and the addition of small amounts of sodium chloride were found to be very effective and cheap; but the rules of the Interstate Cotton Seed Crushers Association prohibited the addition of anything to the seed to be sold as prime seed. Considering that oxygen is required in the heating, a good method of prevention would be to keep the storage bins air tight or filled with gases low in oxygen, like flue gases; but such a construction would come very high.

Besides, seed of high moisture content, if stored with exclusion of air, will putrefy and become quite valueless. The amount of heat evolved depends on the temperature and is small at a low temperature; but if sufficient to raise the temperature of the pile, the generation of heat will increase also, with the result that the temperature will rise faster and faster. If the seed house and the seed were kept at 60 to 70 degrees very little heat would be generated by the seed and very little cooling would be required to keep the seed at that temperature.

Heating of seed is caused by enzymes which require moisture to become active. It is not caused by bacteria. Seed that have been disinfected will heat as easily as seed that have not. Heating is not the natural living process of the living seed, because heated seed will have lost to a great extent or completely their power of germination. Oxidation is the most important chemical process taking place; the sugars are used up first, then the pentosans are attacked and oxidized to carbondioxide. The oils and proteins are not destroyed, but the chemical and physical characters will change. The glyzerides of the oils become hydrolized and the acidity of the oil will increase. The proteins become coagulated and insoluble in a solution of sodium chloride. The cell walls become soft and the kernel dark on account of the coloring matter which becomes oxidized and spreads through the whole kernel. The refining loss of the loss will increase not only on account of the increase in free fatty acid, but because other substances will become dissolved or suspended in the oil. The press cake will have a dark color and an off odor. A cake slightly off can be sold as stock food; but if the seed be badly damaged the cake can be sold for fertilizer only. The oil content of an off cake is higher than of prime cake because it seems that on account of the softness of the seed the oil is not so readily expelled. The time of cooking the meats has to be extended or the steam pressure raised to expel the excessive moisture.

Although great losses are sustained by the oil mills and farmers whenever there is unfavorable weather at cotton picking time very little progress has been made in reducing those losses. The person who discovers a process which will prevent the seed from heating (which process must be applied at the gins to be of great benefit) will become a great benefactor of the cotton oil industry directly and the lard compound, the oleomargarine, and the stock food industry indirectly. A quick and simple method of determining the value of cottonseed when bought would undoubtedly take much of the gamble out of the cotton oil industry that now is prevalent.

A Correction

An advertisement appeared in OIL & FAT INDUSTRIES for April, featuring Dr. Edson's book "The Chemistry & Examination of Edible Oils & Fats. Their Substitutes and Adulterants." The price of this book was announced as being $20.00. The correct price should be $12.50. The publishers of the Journal put it highly important to correct this error, lest the price formerly announced deter anyone from ordering as valuable a book as this.