Cereal Chemistry

An Inexpensive Method for Treating Grain Dust to Prevent Fine Particles from Becoming Airborne During Handling[1]

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NOTE

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Most researchers agree that dust should be removed from grain and sold as a useful by-product. However, because dust is difficult to handle and the small particles easily become airborne, special processing methods such as pelleting, wetting, or adding additives have been considered. Pelleting is expensive (Schnake 1979), and wetting sometimes causes microbiological problems (Lai et al 1979). Spraying the dust with oil (Lai et al 1981) does not harm grain handling equipment and causes no microbiological problems. To minimize processing costs of treating grain dust, so that it can be easily handled without polluting the atmosphere or endangering the health of workers, we employed a Turbulator to thoroughly mix either water or oil with grain dust.

MATERIALS

We used two samples of wheat dust and three samples of commercial corn dust collected by dust control systems in commercial elevators. Three subsamples of each were examined. All samples were typical of those likely to be encountered in commercial grain handling facilities.

We used Carnation brand mineral oil from Witco Chemical Co., New York.

METHODS

To mix dust with water or oil, we used a continuous pilot size model 12T34 Turbulator (300–400 lb/hr) from Ferro-Tech, Inc., (Wyandotte, MI). The experimental setup is shown in Fig. 1. Eight of the pins on the rotating drum were replaced by paddles that were oriented to slow down the exit of the product from the unit. In addition, for some tests, the exiting end of the turbulator was tilted upward 6° to reduce the outlet flow rate.

For preliminary tests, water and oil were added with an applicator pump and flow control unit (Sims et al 1979) supplied by Wyatt Manufacturing Co. (Salina, KS). Because the lowest obtainable flow rate with the pump was about 2% oil or water used on throughput, a graduated buret was used instead of the pump for all subsequent tests. The flow rate was controlled by a stopcock.

After treatment with water or oil, the dustiness of the product was measured by counting with an automatic particle counter the number of dust particles emitted when the sample was dropped under controlled conditions (Lai et al 1981). The dustiness index is defined here as the logarithm of the total number of particles counted. We measured the dustiness index on the treated dust and the untreated dust (control) at 0, 1, 2, and 4 weeks after treatment.

RESULTS AND DISCUSSION

Agglomeration with Water

Water is an effective agglomerate in reducing the dustiness of grain dust (Fig. 2). However, after treatment with water, the moist dust must be dried or used immediately for feed, or it will mold. The dustiness of fine and coarse corn dust was substantially reduced by adding as little as 0.5% water (Fig. 2).

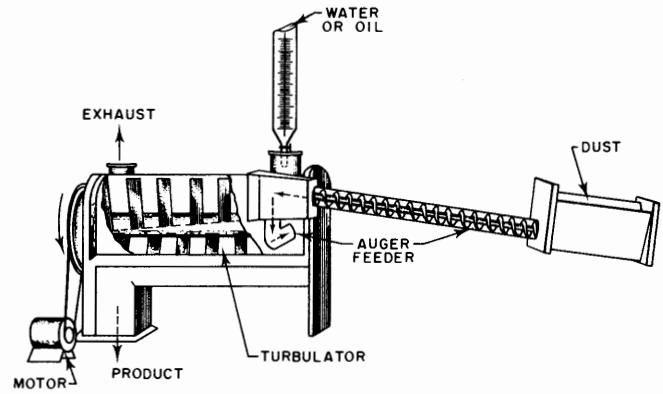

Fig. 1. Equipment for adding water or oil to grain dust.

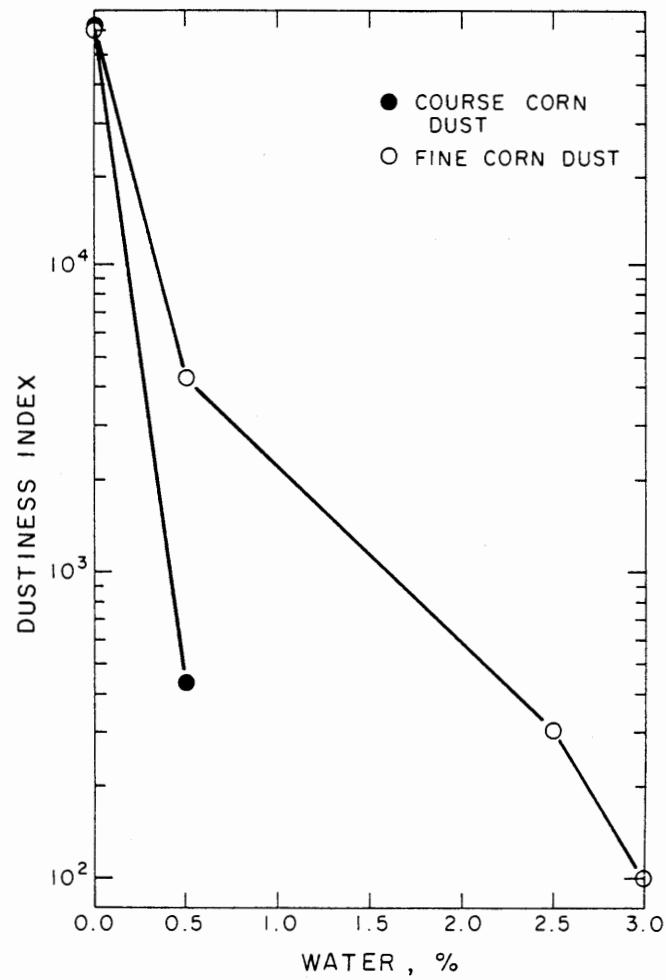

Fig. 2. Effect of water on dustiness of coarse and fine corn dust. Results represent the average of three samples.

[1] Mention of a company or product name does not constitute endorsement by the USDA over others of a similar nature not mentioned.

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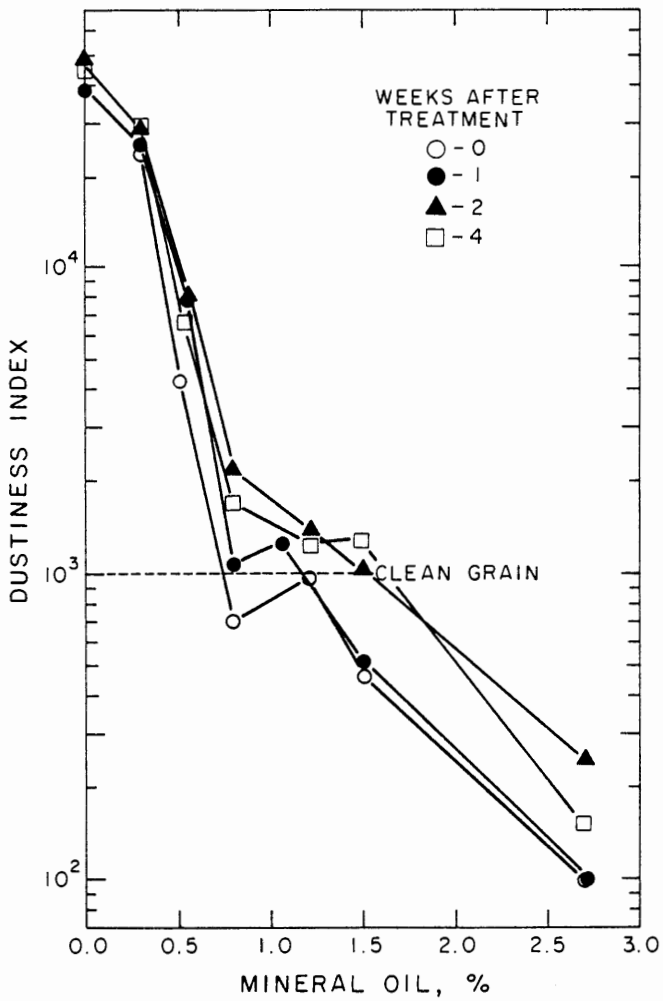

Fig. 3. Effect of mineral oil and storage time on dustiness of corn dust. Results represent the average of three samples.

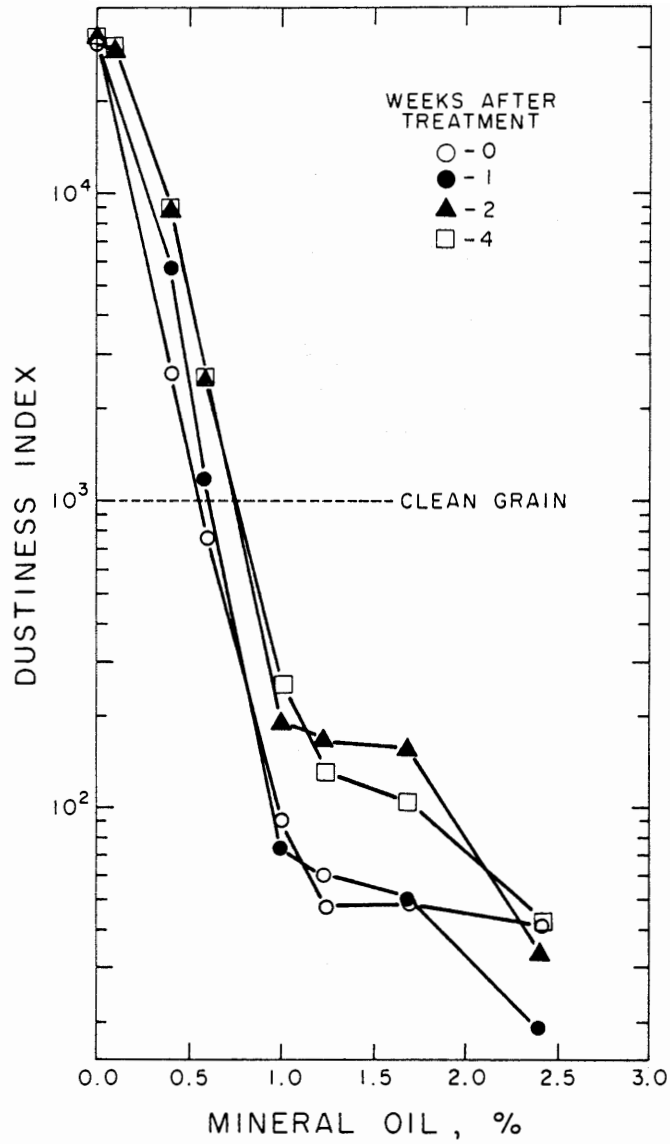

Fig. 4. Effect of mineral oil and storage time on dustiness of wheat dust. Results represent the average of three samples.

Agglomeration with Oil

Oil is a better agglomerant than water because, unlike water, it does not cause dust to mold. We were concerned with the questions of the cost of oil application and its effectiveness over a long period. The immediate effect of treating corn dust (Fig. 3) and wheat dust (Fig. 4) with as little as 0.5% oil was significant. The dustiness index of corn dust was reduced to 0.1 of that for the control when treated with 0.5% oil, and to 0.01 of that for the control when treated with 1.5% oil. The effectiveness of treating corn dust with oil declined with time; however, the reduction of the dustiness index was still substantial after four weeks. After two weeks, the dustiness index of corn dust treated with 0.5% oil was 16% of that for the control. The reduction in effectiveness of the added oil is probably due to absorption of oil into the dust particles.

The effect of treatment of wheat dust with mineral oil was similar to that for corn. Whether the agglomerator was horizontal (Fig. 4) or tilted to 6° from the horizontal (data not shown) made no difference.

Although higher application rates of oil corresponded to lower dust emission, the practical upper limit in adding oil is governed by economics. Because the dustiness index leveled off with the addition of 1% oil to corn and wheat dust (Figs. 3 and 4), and because the dustiness index for clean grain (washed by isopropyl alcohol to remove adhering dust) is approximately 1,000, the application rate of oil to corn and wheat dust should be approximately 0.5%. The operating cost of treating dust with 0.5% mineral oil is estimated at $3–5 per ton, compared to a pelleting cost of $12–72 per ton (Schnake 1979).

Only commercial testing will determine the effect of oil treatment on bridging and handling dust treated with mineral oil.

Regulations permit 600 ppm of mineral oil to be used in feed. Thus, a feed consisting of 12% dust treated with 0.5% mineral oil could be used in an animal ration. A liquid vegetable oil, instead of mineral oil, probably could be used with equal success.

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