

For Publication

SUMMARY OF INFORMATION ON THE
POLYCHLORINATED BIPHENYL (PCB)-SILO PROBLEM

This summary on the PCB-contaminated silo problem was prepared from information provided and opinions expressed at a meeting held on November 27, 1972. The individuals attending the meeting were Lynn B. Willett, Ohio State University; Ronald Wendlandt, University of Kentucky; George F. Fries, ARS; Harry Geyer, ARS; Everett Warwick, ARS; George Mountney, CSRS; and Gerald F. Combs, SRE. Most of the information was provided by the first three, all of whom have had extensive research or Extension experience with this problem.

Conclusions

1. Most of the contaminated silos are located in Ohio, Kentucky, Indiana, Tennessee, and the adjacent areas of adjoining States.
2. Approximately 5000 silos were built in which PCB-containing paint was used.
3. Residues of PCB in milk from farms with these silos can be expected to exceed the FDA tolerance level of 2.5 ppm (fat basis).
4. Because of dilution with other milk, the problem presents no real hazard to the general public.
5. At the usual contamination levels, a member of a farm family consuming its own milk over 3.5 years could consume approximately 500 milligrams of PCBs. This is believed to be the minimal amount which has produced clinical effects in man based on the Japanese experience wherein it was consumed over a much shorter period of time.
6. The cost of replacing a 14'x50' silo is about \$3400 if the hardware is reused.
7. If PCB-contaminated milk is detected by a regulatory agency, the loss of feed and milk could involve an additional \$5000.
8. The only counter measure known to be completely effective is the replacement of the contaminated silos.
9. Cleaning the silo and resealing with a water-base epoxy, hydraulic cement, or a furfuryl alcohol resin has been effective in short-term studies and would only cost about \$400 to \$600.
10. Sand blasting, wire brushing, and high pressure water all are effective methods of cleaning silos before resealing.

11. An educational program carried out through State Extension Services in collaboration with producers and field men of producer groups is considered to be the most practical means of correcting this problem.
- ✓ 12. If PCB contamination could be included under the Pesticide Indemnity Program or if milk could be collected for testing at the farm level, greater cooperation of local producers in eliminating this source of PCB contamination could be expected.

Number and Location of Silos

The silo sealant "Cumar"¹ was developed in the 1930s. It was a private formulation developed and used by the Concrete Silo Company.² In 1966 the assets of the Concrete Silo Company were divided among three successor companies, all of which use the Cumar material. The successor companies were the Michigan Silo Company, the Bloomfield Silo Company, and the Monteaugle Silo Company. The activities of the three companies

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Cumar is the name of a coating used by several midwestern silo companies and is responsible for most, if not all, of the Aroclor-contaminated silos. This coating contains 70-lb Aroclor 1254 and 20-lb Aroclor 5460 per 47 gallons of paint. It should not be confused with Neville R-1-6A resin that has the same name.

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There are discrepancies in the name of the original company depending on the source of information. In some versions, the Michigan Silo Co. was the original company. Its name was changed to the Concrete Products Co. which later divided into the three companies.

centered in Ohio, Indiana, Kentucky, and Tennessee. In addition to these States, it is known from regulatory experience and from information supplied by the silo companies that the following additional States also have contaminated silos: Michigan, Illinois, Alabama, Georgia, North Carolina, South Carolina, Pennsylvania, Maryland, West Virginia, Virginia, and New York.

Estimates of the number of contaminated silos built since the 1966 reorganization are available from the three companies. Michigan Silo has reported 108 sales of Cumar during this period. Mounteagle built 350 silos while Bloomfield built 245 silos in Kentucky during this period. The number of silos built by Bloomfield in other States during this period is not available. As many as 1000 silos may have been built by the three companies during this period. The records of silos built before 1966 were not available and it is our impression that they do not exist.

Fries has estimated that about 5000 contaminated silos were built. This was based on the production of 1000 silos during the last 4 years. If 20 years are assumed as the period of active construction and the rate did not change, 5000 silos would have been built. A Mounteagle representative has also estimated that about 5000 to 6000 silos were built by the present and predecessor companies.

In 1970 the Baltimore office of the Food and Drug Administration detected six farms in the Martinsburg, West Virginia, area that had contaminated silos. All of these farms had Michigan silos built by the same builder. Only one of these farms was on the list of sales by Michigan Silo after 1966. While the sample is small, the numbers are consistent with the conclusion that about one contaminated silo in five was built after 1966.

It was realized that some of the silos are not being used, have been torn down, or are on farms other than dairy farms. Considering these points, it was felt it would be helpful to perform a survey of individual milk samples in a given location in order to provide more information about these questions. Such a survey is possible in a region of Kentucky where 230 farms were shipping to a single cooperative. Because some of the shippers have been detected with PCB residues, the cooperative has been quite interested in checking all of the individual producers. With this study Fries and Wendlandt would hope to learn (a) the number of silos that exist; (b) whether or not there are any other sources of contamination; (c) the number of silos built before 1966 compared to the number built after 1966; and (d) to determine if it is possible for experienced individuals such as field men of this company to determine before the analysis which of the farms are likely to be affected.

Significance of Residues

The significance of the contaminated silos can be evaluated from two viewpoints: as a possible health hazard to the general public and as a possible health and economic hazard to the dairyman and his family.

The situation does not present a significant health hazard to the general public. Most of the contaminated silos are dispersed and milksheds usually include a large number of farms. It is unlikely that any mixed milk supply will have significant PCB residues. This conclusion has been confirmed by FDA surveys.

The significance of the problem for the individual farm family may be considerably different. As a general rule, farms with these silos

produce milk containing approximately 10 ppm PCB in the milk fat. Levels 2 to 3 times higher have been found in a few cases. If the farm family drinks their own milk, a residue level of 10 ppm and consumption of 1 liter per day would provide an 0.5 gram intake of PCB in 3.5 years. Short-term intake of 0.5 gram PCB has caused adverse effects in humans. Long-term intake is probably not as serious as the short-term intake because a larger portion of the dose will be excreted. However, the possible subacute effects of long-term intake have not been evaluated.

A second hazard to the dairyman is economic. The actionable level for PCB residues in milk fat is 2.5 ppm. Almost without exception, dairymen with these silos will be producing milk with residues above the actionable level. If a dairyman is detected and removed from the market, his financial losses will be substantial. The exact loss depends on a number of factors such as size of operation, time of year, feeding program, etc.

Three sources of loss are the silo, the silage in the silo, and the milk. Using a 14 x 50 concrete-stave silo as an example, replacement cost was estimated by Willett to be about \$3400 if the hardware, roof, unloader, etc., could be reused. Cleaning and resealing could reduce this cost to \$400 to \$500.

The loss of contaminated feed can be quite variable. The 14x50 foot silo could contain as much as 160 tons of silage. If all of the silage were lost, it could cost \$3,000 to replace it with hay even if one used the low price of \$50 per ton of hay. This cost would be proportionately less if some of the silage had already been fed when the silo was detected.

The value of the lost milk could easily be the most significant item.

A 14x50 foot silo would provide enough silage for half the dry matter intake of 40 cows for a 6-month period. If the dairyman lost his market and the initial concentration of residues was 10 ppm, it would require approximately 10 weeks to return to the market. If the 40 cows were producing 30 pounds of milk per day and the value of the milk was \$5.00 per hundred, the lost production would be worth about \$4,000.

When the cows are producing unmarketable milk, their body fat residues are also too high for sale as beef. Thus, the dairyman would not be able to reduce his losses by selling the contaminated cows and replacing them with clean cows.

Eliminating Residues

The most effective way to remove the PCB problem is to replace the silo. While this approach is the most effective, it is also the most expensive. It will probably cost the livestock producer in excess of \$4000.00 to replace the silo.

The results of a research program at the Ohio Agricultural Research and Development Center (OARDC) have indicated that PCB residues can effectively be reduced in contaminated silos. These results have been achieved by carefully cleaning and recoating silos with materials that form a barrier between the silage and the silo wall. The cost of cleaning and recoating a silo is between 10 and 18% of the cost of replacing the silo, depending on the type of coating used. This research is now being continued to determine if silage from these recoated silos can be safely fed without contaminating the milk and also to determine if the coating continues to be an effective barrier when the silo is used continually.

Possibly the most important aspect of recoating a silo is the cleaning of the silo walls prior to applying the coating. Coatings will not be effective unless a clean and solid surface is prepared. Sandblasting is an ideal means to clean the silo, but the cost is greater than 50% of the replacement cost. Dust must also be controlled when sandblasting is used to prevent widespread contamination.

Alternatives to sandblasting are wire brushing and high-pressure water (500 psi). The wire brush method requires a great deal of labor. When high-pressure water is used, the run-off must be controlled to prevent contamination of streams or other parts of the farm. Under no circumstances should an organic (gasoline, etc.) solvent be used to clean the interior of a silo. The solvent would only serve to spread the PCB contamination and would interfere with the bonding of a new barrier coating.

Research has provided information about some of the necessary properties of coatings if they are to be used as effective barriers to PCB residues. First, it should not contain a solvent in which the PCB is soluble. This type solvent would dissolve the PCB from the silo wall and make it part of the new coating. A solvent-based coating may make the contamination more severe than if no new coating was used. Second, the new coating should provide a thick barrier between the contaminated silo wall and the silage. This means that two or more coats of the material are necessary.

Three coating systems, of 12 tested, are promising as a means to cover the previously contaminated silo surface. These are: a hydraulic cement^{1,2}

¹ Hydraulic cement is not a sand and cement plaster but a special cement that forms a water tight barrier.

² Thoroseal® - Standard Dry Wall Products, Inc., Miami, Fla.

with an acrylic bonder³, a water-based epoxy⁴, and a furfuryl alcohol resin⁵ coating. Testing of these materials is continuing to determine how long these coatings will continue to be effective barriers to PCB residues, when a silo is used continually. The aforementioned coatings, when applied to contaminated silos, reduced the level of PCB residue in the silage adjacent to the silo wall to less than 4.0 ppm (dry matter basis). Preliminary research results suggest that if the level of PCB in the silage adjacent to the wall is less than 5.0 ppm, the milk produced by cows that consume silage from the silo will be less than 2.5 ppm (fat basis).

Identification and Elimination of Contaminated Silos

There are several points to consider before proposing methods of identifying and eliminating contaminated silos. Under present circumstances, the dairyman may not be too concerned about checking his silo for contamination or correcting such a problem if he has had no difficulty marketing his milk. This situation could change rapidly if the producer realizes the potential danger to his family and the losses he would incur if regulatory agencies sampled milk at the farm level and found his to be contaminated..

³ Acryl-60* - Standard Dry Wall Products, Inc., Miami, Fla.

⁴ 009 Epoxy* - Action Plastic, Inc., Charlotte, Michigan.

⁵ Silenzcrete* - Universal Cooperatives, Alliance, Ohio.

* The use of trade names is only to identify the products used. The use of these names is not an endorsement of the products used nor meant to discriminate against similar products not mentioned.

This situation almost precludes the possibility that the Department could become involved in an active program of detecting contaminated silos. If they were detected it would be necessary to report them to the regulatory agencies. It is doubtful if many dairymen would be interested in cooperating.

The Department could probably only work in an educational roll presenting the facts of the situation, the consequences of action or no action, and providing assistance in locating laboratories to perform analyses. The program could be carried out either through the Extension Service or through the fieldmen of processor groups. The latter possibility is worth exploring because the fieldmen will be in contact with all producers rather than just some as is often the case with Extension. A second possible benefit from working through the processors is the possibility that there will be greater incentive to do something because the processors have an obligation to produce a wholesome product.

The situation could change drastically if one of two events occur. If regulatory agencies step up their activity, there will be greater advantage to the individual farmer to determine whether or not he has a contamination problem. As noted above, the cost of cleaning up a silo before detection by regulatory agencies is considerably less than the cost after a regulatory agency detects him. The second possible change would be the inclusion of PCB contamination under the pesticide indemnification program. If the dairyman does not feel that it will cost him a considerable amount of money, he will more likely determine if he has a problem.

It should be noted that Monsanto Chemical Company has assumed partial

responsibility for the cost of cleaning a number of silos built since 1966. They have generally become involved only after the detection by regulatory agencies. While this will not affect the old silos, it is a matter that could be explored further in any clean-up proposal.