DECONTAMINATION OF SILOS CONTAMINATED WITH POLYCHLORINATED BIPHENYLS (PCB's)--SOME IMPORTANT CONSIDERATIONS

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The organic acids produced during the ensiling process attack and erode the surface of concrete silos. Whether a silo is of poured or stave concrete construction, the walls are porous and therefore a large surface is subject to attack (Fig. 1A).

For many years various coating materials have been used to lessen erosion of the silo wall. Generally these coatings have taken the form of: 1) an *expendable* concrete plaster, 2) a material to fill the pores in the concrete which reduced the surface subject to acid attack, and 3) barrier coatings which prevent the contact of organic acids with the silo wall.

One such barrier coating was *Cumar*, which contained polychlorinated biphenyls (PCB) and terphenyls (PCT) in its formulation. This material was first used in the early 1940's, with application as a protection for the grouting between concrete stave blocks and as a silo surface coating.

When Cumar was applied to the silo wall, the solvents of the coating penetrated into the concrete, thus carrying the PCB and PCT residues into the silo wall (Fig. 1B). After the Cumar cured, there did not appear to be any impetus for further migration of the residues.

When the silo was filled, the organic acids produced dissolved some of the PCB's from the Cumar coating, thus contaminating the silage (Fig. 1C). Then this PCB residue diffused through the silage away from the silo wall.

With time, failure of the Cumar coating occurred and flakes of this material, which fell into the silage, caused localized areas to become highly contaminated (Fig. 1D).

In areas where the Cumar had failed or had completely come off the wall, the organic acids from the silages penetrated into the pores of the silo wall and dissolved some of the PCB residues (Fig. 1E). These residues then diffused into the silage. Silos, last coated with a PCB-containing coating 16 years ago, still cause significant contamination of the silage long after all traces of the coating are gone.

During the past 2 years, research on the decontamination of PCB-containing silos has been conducted in the Department of Dairy Science at OARDC. This research has demonstrated that PCB residues from a silo can be effectively reduced by cleaning the surface of the PCB-contaminated silo and recoating the surface with a material which will prevent contact between the silage acids and the concrete walls which are PCB-contaminated (Fig. 1F). Considering time, expense, and convenience, recoating is a more practical approach in many instances than removal of the silo.

If a silo is to be decontaminated by recoating, dirt and loose particles of old coatings and/or deteriorating wall surface must be removed.

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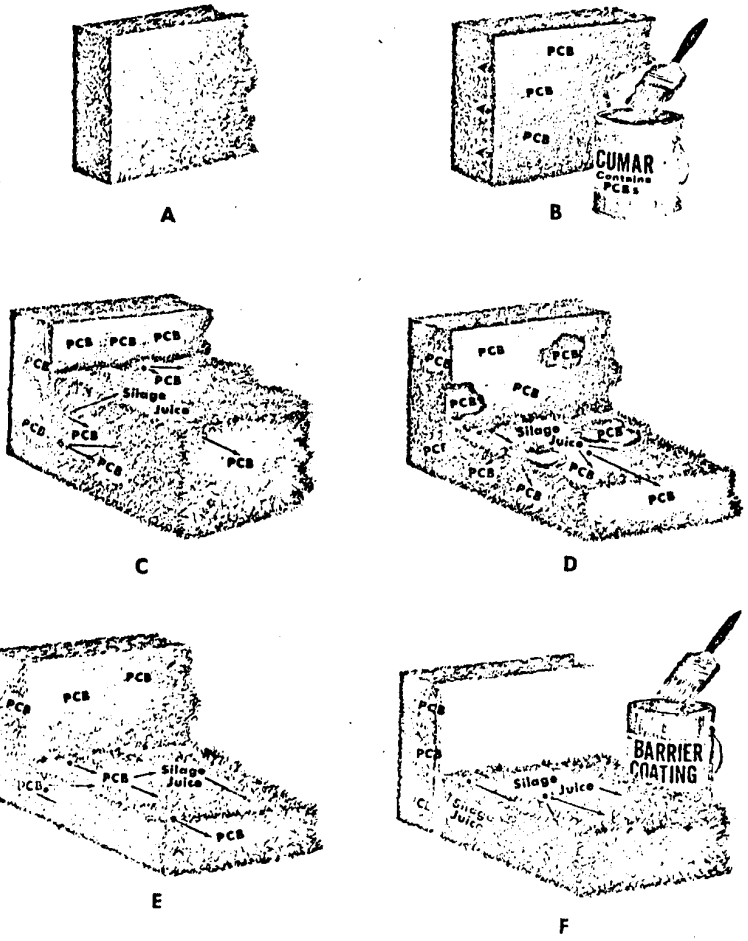

FIG. 1.--The porous concrete surface of many silos was protected with Cumar which contained PCB's. The PCB's from this coating contaminate the silage when they are dissolved by the silage juices or flake off. Certain barrier coatings can prevent PCB contamination of silage.

Sandblasting is an excellent method of cleaning a silo wall surface upon which a new coating is to be applied. When this method is used, care should be taken to control the dust, debris, and sand as these can spread PCB contamination to other areas of the farm. However, the expense involved with sandblasting makes this approach impractical under most circumstances.

Washing the surface with high-pressure water (500 p.s.i.) has been shown to be an effective means of cleaning silo walls. When this method is used, the runoff must be controlled to prevent PCB contamination of waterways. Time must be allowed for the silo walls to dry prior to application of the coating. Therefore, some delay must be considered when water is used. This is particularly important in the winter when frost may build in the silo walls, preventing good bonding of the coating.

Wire brushing of the silo surface is also effective but requires a great deal of time and labor.

A special problem is presented in preparing to recoat a silo which still has a previous coating intact or was constructed of wax-treated blocks. Unless the surface is removed or a firm rough surface prepared, the chances of good bonding of the new coating are greatly reduced. A coating should never be removed with an organic solvent, as this method will spread the PCB contamination and may leave the surface unfit for recoating. With solvents, there is also the danger of fire and/or toxic vapors. Sandblasting may be the best way to remove an intact coating.

The coating used as a barrier to PCB's must withstand the harsh environment inside a silo, plus prevent the acids in silage juices from reaching the silo wall. Some of these coating properties are listed below.

1. The coating must bond well to concrete.

2. It must be waterproof, non-porous, and cover completely.

3. It must be acid-resistant, as pH values as low as 3.5 are encountered.

4. Temperature ranges from below freezing to 160° F. must be withstood without failure.

5. It should be tough so that machinery, such as unloaders, don't cause it to flake off.

6. The coating should not contain chlorinated hydrocarbons or toxic chemicals which will contaminate the silage.

7. The coating should meet Occupational Safety and Health Act (OSHA) standards to protect the workers applying the material from toxic or flammable vapors. Likewise, the product needs to meet local air pollution control regulations.

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8. The coating should not contain a solvent in which PCB's are readily soluble, as PCB's from the silo wall may migrate into the new coating as it is applied.

9. Application of the material should be uncomplicated.

10. The cost of the coating should be low enough so that the entire recoating operation is not excessive when compared to the cost of replacing the silo.

Before purchasing a silo coating, the owner should obtain a guarantee from the manufacturer stating that the product does not contain chlorinated hydrocarbons or toxic chemicals which may contaminate the silage.

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