AN OVERVIEW OF OPTIONS FOR DISPOSAL OF VINYL PLASTICS IN MUNICIPAL SOLID WASTE

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Vinyl plastics, or PVC represent the second-largest selling thermoplastic in the United States with production last year at 8.35 billion pounds. Consumption of PVC in its various applications amounted to 8.26 billion pounds and the compound growth rate for this plastic has been approximately 4.4% over the past 10 years. The largest uses of PVC are in building and construction, where some 62% of product is consumed. The largest use is that in pipes and fittings where the growth has been at a rate of 4.7% per year. Largely, vinyl is used in applications where it does not reappear in the municipal waste stream for many years. This includes such permanent uses as pipe fittings, drain waste and vent piping, siding, windows, wall coverings, louver drapes and leaders and gutters.

The use of vinyl in disposal products, such as packaging has been relatively unchanged over the past 6 years, and is in the area of 600 million pounds per year. This includes rigid bottles used in such applications as the packaging of non-carbonated water, oil, peanut butter, window washing fluid and automotive products. In addition, flexible vinyl film has been used in meat wrap for many years.

While vinyl packaging material is an insignificant contributor to the solid waste stream, the major manufacturers of vinyl resins have embarked on a multi-faceted program to develop information on alternative methods for the safe disposal of PVC in the waste stream. This work has been carried out in answer to the concerns of legislators and regulators, and at the same time, to develop practical information concerning the recovery of vinyl plastics.

Without considering the make-up of the municipal solid waste stream, a hierarchy of options can be established for managing solid waste. Arranged in an order of decreasing environmental acceptability, these are:

1. Source reduction and product bans.
2. The reuse of packaging or shipping containers
3. Recycling
4. Incineration with resource recovery.
5. Landfilling

Source reduction or product bans are voluntary marketplace-driven activities or may be mandated. There is no real benefit in terms of solid waste management, and as a matter of fact, there may be some negatives if the replacement material consumes a greater volume of space in a landfill, or if it is not itself, recyclable. The reuse of packaging or shipping containers is a fairly old practice, and, assuming that the container can be properly cleaned, so as to avoid product contamination, there is a measurable advantage for reuse. Ultimately, however, the container will have to be disposed of in an environmentally-satisfactory manner, as it may no longer be usable, due to damages, cracks or leaks.

This presentation will largely concern itself with information on the recycling of vinyl plastics. There are some key considerations to be made when considering recycling including:

1. If an individual plastic is to be recovered, separation of the plastic containers, and sortation either at the source or a material recovery facility is required.

2. Unless the package is easily identifiable because of its use, i.e., soda bottles or milk containers, some type of container coding is needed, since a large variety of plastics are used in packaging.

3. Flexible packaging is very difficult to recover, as it requires washing or clean-up, separation and some form of densification.

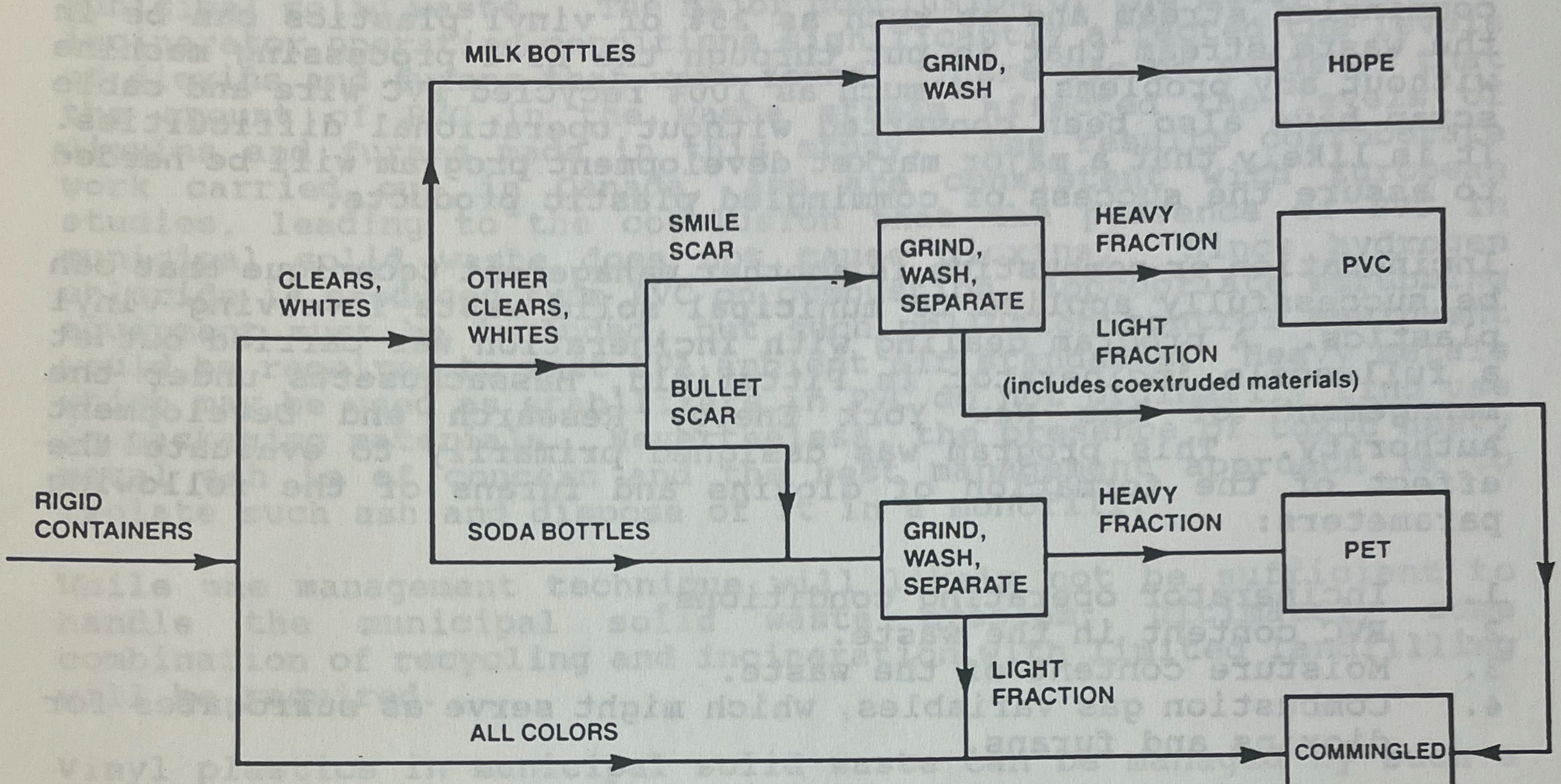
4. Multi-layer composite packaging results in many different plastics in a single package and technology does not now exist for separating these components.

5. There is generally a disparity between the availability of recycled material and the amount needed for second generation products.

6. Second generation products should have a longer life than the original disposable packaging material.

7. Recycling cannot go on indefinitely, and does not solve the solid waste problem.

A flow sheet for the separation of rigid containers is shown below:



PET can be separated from PVC by observing the molding scar at the bottom of the container. At the present time, use of this scheme requires hand sortation and as such, is a slow process, subject to human error. Efforts are underway to develop a mechanical sorting technique, based on x-ray fluorescence technology. A process involving a laser scanning technology, which is highly computerized, has been developed by Govoni and is reportedly operating in Italy and being introduced in Sweden and France. Work to develop a sortation/separation technique is being supported by the Plastics Recycling Foundation in work at Rutgers University, and special emphasis to the removal of vinyl plastics is being supported by the Vinyl Institute. Until such a mechanical sorting technique is available, coding of containers made from PVC using a coding system introduced by the Society of the Plastics Industry, will be useful in assisting recycling operators in the identification of vinyl-based containers. PVC recovered from such operations can be used in making foam core, large diameter pipe and other large volume uses exist, principally in sewer and irrigation pipe.

A second form of recycling, which does not involve the separation of PVC has been investigated in a project at the Center For Plastics Recycling Research at Rutgers University. This work has demonstrated that vinyl can be a significant portion of the commingled stream and as much as 25% of vinyl plastics can be in the waste stream that is put through the ET-1 processing machine without any problems. As much as 100% recycled PVC wire and cable scrap have also been converted without operational difficulties. It is likely that a major market development program will be needed to assure the success of commingled plastic products.

Incineration or combustion is another management technique that can be successfully applied to municipal solid waste involving vinyl plastics. A program dealing with incineration was carried out at a full-scale incinerator in Pittsfield, Massachusetts under the management of the New York Energy Research and Development Authority. This program was designed primarily to evaluate the effect of the formation of dioxins and furans of the following parameters:

1. Incinerator operating conditions.
2. PVC content in the waste.
3. Moisture content of the waste.
4. Combustion gas variables, which might serve as surrogates for dioxins and furans.

The matrix of the experimental design of the final phase of the program is shown below:

Type of Waste	Temperature of Primary Chamber °F 1300	1400	1550	1800
MSW	•	•*	•	•
MSW + H_2O			•	
MSW + PVC**				•
MSW (low O_2)				•
PVC-Free				•
PVC-Free + PVC***				•
PVC-Free + H_2O				•

* Only one run was carried out under this conditions; duplicate runs in all other cases.

** Sufficient PVC was added to MSW to bring the total chlorine content to 1.3% from ca. 0.3%.

*** PVC was added to bring the chlorine content to 0.3% (as in normal MSW).

In the experimentation, sufficient PVC was added to result in a chlorine level approximately 4 times that normally found in municipal solid waste. The major conclusion of the study was that incinerator operating conditions significantly affected the levels of dioxins and furans that were found. There was no evidence that the amount of PVC in the waste stream affected the levels of dioxins and furans made in this study. The results corroborate work carried out in Canada, and are consistent with European studies, leading to the conclusion that the presence of PVC in municipal solid waste does not cause dioxins. Since hydrogen chloride is produced from PVC on combustion, appropriate scrubbing equipment must be included, but such pollution control equipment would be required to meet EPA ambient air standards. Heavy metals which may be used as stabilizers in PVC do not ordinarily find use in packaging materials. Nevertheless, the presence of toxic heavy metal ash is of concern and the best management approach is to isolate such ash and dispose of it in a monofill.

While one management technique will likely not be sufficient to handle the municipal solid waste problem, ultimately some combination of recycling and incineration with limited landfilling will be required.

Vinyl plastics in municipal solid waste can be managed by such a combination of techniques.