

B. F. Goodrich Chemical Company
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DEVELOPMENT CENTER

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**Degradation and Combustion
Products From Poly(vinyl chloride)**

**III - Flame Retardant Characteristics of
Experimental PVC Latices**

by
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I - MAJOR OBJECTIVES

The major objectives of this research problem are:

- 1) to construct a pyrolysis unit for carrying out the thermal and thermo-oxidative degradation of polymeric materials, and
- 2) to develop the required analytical techniques for measuring, qualitatively and quantitatively, the typical volatile thermolysis and combustion products from polymers.

Long range studies are presently planned for application of this newly developed technique in the following problem areas:

- 1) the toxicity of degradation and combustion products,
- 2) the relationship between polymer structure and types of degradation products produced,
- 3) the mechanism of flame retardation,
- 4) the evaluation of flame retardants, and
- 5) polymer identification (fingerprinting).

II - LIMITED OBJECTIVES

The limited objective of the current study is to correlate the observed flame retardant characteristics of various PVC latices with the types and quantities of fuels that are produced from these latices when subjected to thermal degradation.

III - SUMMARY AND CONCLUSIONS

- 1) The pyrolysis products from two experimental PVC latices containing various levels of n-butyl acrylate, 2-ethyl hexyl acrylate, acrylic acid, and 2-chloroethyl vinylphosphonate were analyzed. The results of these analyses indicated that over 15 degradation products were produced when the two experimental polymers were thermally degraded in a helium atmosphere at 500°C.

- 2) The major degradation products (19) have been separated and identified with the gas chromatographic - mass spectrometer system. Minor degradation products (Total:16) were not identified due to instrumental limitations. The major products are:

- 1) HCl
- 2) Methane
- 3) CO₂
- 4) Ethylene
- 5) Ethane
- 6) Propane
- 7) Propylene

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- 8) Vinyl Chloride
 - 9) Butane
 - 10) Butane + C_4H_6
 - 11) Dichloroethane
 - 12) Chlorobutane
 - 13) Chloropropane
 - 14) Benzene
 - 15) Dioxane
 - 16) C_3 Olefins
 - 17) Chlorobenzene
 - 18) Dichlorobenzene
 - 19) Naphthalene
- 3) A semi-quantitative analysis of the major degradation products from the two experimental polymers has been completed. The results of the two analyses show that the polymer exhibiting inferior flame retardant characteristics produces, upon thermal degradation, three times as much low boiling, highly flammable products as does the polymer exhibiting superior flame retardant characteristics.

IV - FUTURE ACTION

- 1) In view of the initial success of this technique, a computer-based correlation study of typical pyrolysis products from a series of experimental polymers and the observed flame retardant characteristics of these polymers is planned.
- 2) Pyrolysis of these experimental polymers at lower temperatures is planned in order that:
 - (a) a range of flame temperatures may be simulated, and
 - (b) the effect of temperature on the kinds and amounts of degradation products may be known. Thermogravimetric analysis will be utilized in this area of the problem.

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