

scale-up of such a discharge tube it would therefore be expected that the atom loss rate would become diffusion controlled, resulting in an increased efficiency of oxygen atom production.

A. M. MEARNS
A. J. MORRIS

Department of Chemical Engineering,
University of Newcastle upon Tyne.

Received September 23, 1969.

¹ Kaufman, F., and Kelso, J. R., *J. Chem. Phys.*, **32**, 301 (1960).

² Shaw, T. M., in *Formation and Trapping of Free Radicals* (edit. by Bass, A. M., and Broida, H. P.), 47 (Academic Press, New York, 1960).

³ Brown, R. L., *J. Phys. Chem.*, **71**, 2492 (1967).

⁴ Kaufman, F., *Chemical Reactions in Electrical Discharges, Adv. in Chem. Series*, No. 80, 29 (A.C.S., Washington).

⁵ Fehsenfeld, F. C., Evenson, K. M., and Broida, H. P., *Rev. Sci. Instrum.*, **36**, 294 (1965).

⁶ Kaufman, F., *Proc. Roy. Soc., A*, **247**, 123 (1958).

⁷ Kaufman, F., and Kelso, J. R., *Disc. Faraday Soc.*, **37**, 26 (1964).

New Durable Flame Retardant Finish for Polypropylene Textiles

THE inflammability of polypropylene fibres is particularly hazardous when they are used for clothing or carpeting¹. One way of making polypropylene textiles flame retardant is to incorporate certain halogen containing compounds, frequently in combination with antimony oxides or phosphorus donors which improve the effectiveness of the halogen, into the resin before the fibres are extruded². Alternatively, a variety of chemical finishes can be applied to the many commercial forms of the textiles, from monofilaments to apparel fabrics³. The first approach usually needs additives in quantities of up to 30 per cent or more of the weight of the polypropylene fibres. Serious degradation of physical strength can result, as well as deterioration of light, heat and chemical stability and textile handling properties⁴. In the second method, the great chemical inertness of polypropylene makes it difficult to apply a durable finish with suitable flame retardant qualities.

We report the development of a new durable flame retardant finish for polypropylene textiles. *Bis*-(beta-chloroethyl) vinyl phosphonate, $\text{CH}_2=\text{CH}-\text{PO}-(\text{OCH}_2\text{CH}_2\text{Cl})_2$, with a 13.3 per cent phosphorus and a 30.4 per cent chlorine content, is a monomeric ester of obvious relevance because of its vinyl reactivity (in spite of being somewhat passivated by the phosphono group), low vapour pressure (128°–130° C under 1 mm pressure), relative inertness to hydrolysis and potentially moderate cost; it is prepared from phosphorus trichloride and ethylene oxide (see also ref. 5). *Bis*-(beta-chloroethyl) vinyl phosphonate is difficult to homopolymerize by a free radical mechanism to high molecular weight polymers but undergoes copolymerization with other vinyl monomers quite readily⁶. Accordingly the phosphonate was copolymerized with selected acrylic monomers on to polypropylene textiles. We found that copolymerization with *n*-methylolacrylamide, acrylamide, acrylonitrile and similar monomers could be used to produce a suitable finish.

In one set of experiments we used 100 per cent polypropylene, style 37-4237-00, count 49 x 36, weight 6.64 ounces per square yard, obtained from West Point Pepperell, New York. *Bis*-(beta-chloroethyl) vinyl phosphonate came from the Stauffer Chemical Co., Dobbs Ferry, New York, and *n*-methylolacrylamide from the American Cyanamid Corp., New York. The *n*-methylolacrylamide was provided as a 60 per cent aqueous solution. Samples of this polypropylene fabric, about 1 square foot in area, were dipped in solutions containing various ratios of the two compounds together with different amounts of ammonium persulphate catalyst in methanol and water and squeezed to a wet pick-up range of 60 to 120 per cent. The samples were

heated in an air circulating oven at temperatures from 80 to 120° C for predetermined time periods; they were washed in hot water (80°–90° C) and dried to constant weight to determine total resin pick-up. Preferred specific experimental conditions included a 5/1 weight ratio of the phosphonate and the *n*-methylolacrylamide in solutions containing about 50–60 per cent of the monomers and 2 per cent by weight of ammonium persulphate (based on the total weight of the monomers). Curing for 45–60 min at 120°–125° C was most effective. Weight increases after washing were of the order of 20–30 per cent of the weight of the polypropylene fabrics.

The flame retardancy of the modified fabrics was evaluated by the vertical bunsen test (Method 5903, Fed. Specific CCC-T191) and the limiting oxygen index (LOI test)⁷. The samples met the requirements of the vertical bunsen test and had a limiting oxygen content of 0.283, which classified them as flame retardant and self extinguishing. The limiting oxygen index value for untreated polypropylene was 0.195. Physical strength properties such as tensile strength and elongation were somewhat lower and the treated fabrics felt significantly stiffer, although conventional softening agents could be added to the treating solution. The finish was subjected to laundering tests such as those described in Method 5556 of Fed. Specific CCC-T191, consisting of a series of suds and rinse cycles with a maximum wash water temperature of 140° Fahrenheit. The tests show that the finish is quite resistant to at least fifteen launderings.

We have also investigated the irradiation curing of monomer impregnated fabrics without a catalyst by exposing them to a 1.5 MeV electron beam accelerator at ambient temperatures in the presence of air. With swelling treatments of the polypropylene fibres before monomer impregnation and irradiation with dosages of the order of 4–6 Mrads, the preliminary results are promising. The same treatments seem to be equally good for cellulosic fibres and certain other synthetic textile materials. We are continuing experiments to improve the flame proofing treatment and to investigate its mechanism.

A. ADLER
W. BRENNER

Department of Chemical Engineering,
New York University,
University Heights,
New York,
NY 10453.

Received September 29, 1969.

¹ *American Textile Reporter*, 11 and 35; 13, 15 and 52; December 19, 1968.

² Hilardo, C. J., *Flammability Handbook* (Technomic Publishing Co., Inc., Stamford, Connecticut, 1969).

³ Segall, W. M., *Sources and Resources*, **2**, 12 (1969).

⁴ Mark, H. F., Atlas, S. M., and Cernia, E., *Man Made Fibers Science and Technology*, **3**, 392 (Interscience Publishers, New York, 1968).

⁵ Leupold, E. O., *USP*, 2,959,809 (1960).

⁶ Muray, B. J., *J. Polymer Sci., C*, **1869** (1966).

⁷ Seaman, R. E., *Proc. Text. Res. Inst. Spring Meeting* (New York, 1969).

BIOLOGICAL SCIENCES

Specific Action of α -Amanitin on Mammalian RNA Polymerase Protein

Most inhibitors of RNA synthesis act on the DNA template rather than directly on the polymerizing enzyme. Antibiotics that inhibit RNA synthesis by binding to DNA include actinomycin D¹, miracil D², nogalomicin³, chromomycin A₃⁴, aflatoxin⁵, echinomycin, daunomycin, mithramycin and olivomycin⁶, ethidium bromide⁷, proflavine⁸, nitrogen mustard⁹ and acetylaminofluorene¹⁰. In each case tested, there is evidence that the antibiotic can inhibit RNA synthesis in both animal and bacterial