"OTHER NASA-DEVELOPED MATERIALS & SOME INDUSTRIAL APPLICATIONS"

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Dr. Radnofsky served from 1961 to 1966 as Assistant Chief of the Apollo Support Office and as the Systems Manager for the Apollo Suit Program, Crew Systems Division, where he was responsible for monitoring Apollo Suit Programs. In July, 1966 he transferred to NASA Headquarters as Senior Systems Scientist with the Office of Manned Space Flight where he worked on advance missions analysis in the areas of materials and human engineering.

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MATERIALS THAT WON'T BURN

A PRODUCT OF SPACE RESEARCH WITH NONSPACE APPLICATIONS

by

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One of the prime goals of the manned space program is, and always has been, to make NASA-sponsored technology available for the general benefit of an earth-bound populace. It is a goal of which you may be only dimly aware--but let us hope that at the conclusion of these remarks, you will join with us in enthusiastically seeking new applications for space age materials and technology.

Since the inception of the manned spaceflight program, NASA has been actively engaged in a search for nonflammable materials to be used within the spacecraft. This NASA search, conducted with the assistance of industry, had led to a progression from the relatively unsophisticated flameproof materials available ten years ago to the great variety of fibers, cellulosics, elastomers, and composites which can now be fabricated into nonflammable or fire-retardant end items.

The ability to fabricate has, of course, necessitated the development of a technology capable of evaluating and properly utilizing the specialized materials now available. With this technology in hand, we believe that many of the nonflammable and fire-resistant materials developed for spacecraft usage can, when properly adapted, make a significant contribution to the industrial, construction, transportation industries, to the public services, and to domestic and institutional concerns.

We have made a small, but we believe significant, step by carving out several small slices of this large pie for special attention; fire suits and protective garments, aircraft refurbishment, and housing modular fireproof testing. Each of these programs will be discussed in some detail in this paper.

It is, of course, necessary in any evaluation and test program of this type to know first of all what nonflammable materials are available, then to assess their properties, and finally, to choose those materials with properties, including cost and availability, most applicable to

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the particular end use. So we will begin our discussion with materials which are available and which are either nonflammable or fire-retardant under specific conditions.

Some of these materials, developed specifically for the space program, are nonflammable even in oxygen atmospheres. This type of nonflammability would result in "over kill" for domestic application, unless this nonflammability is coupled with such desirable traits as low cost and excellent physical characteristics.

Fibrous Materials

Undoubtedly, the highest degree of nonflammability can be obtained with inorganic fibers such as asbestos and fiberglass. Assemblies containing asbestos exhibit a high degree of resistance to the conductive passage of heat and are used in the spacecraft to fabricate containers for flammable contents.

The fiberglass used most extensively within the spacecraft is called Beta, a fiber characterized by an extremely fine diameter. Textile structures can be fabricated from Beta to provide the maximum in flexibility and performance within the limits of the inherently low abrasion resistance of fiberglass. Various techniques have been used successfully to improve the abrasion resistance of Beta--techniques which have generally centered around the use of coatings, applied to either the woven fabric itself or to the individual yarns before weaving.

Several treatments have been developed which, when applied to aromatic polyamide fibers, yield fabrics that are nonflammable in air and in moderately enriched-oxygen atmospheres. Two of these materials, Durette and Fypro, are discussed in detail under specific fireproofing applications. These treated fabrics exhibit the same excellent physical and fabrication characteristics as the base material, and can be supplied woven, knitted, or as batting. Natural colors of the fibers are golden, dark brown, and black; however, developmental efforts to dye the fibers with colors of requisite fastness are underway.

A phenolic-type fiber called Kynol, which retains its whole identity when exposed to flame temperatures up to 2500^{o}F, has recently been developed. This fiber was originally used mostly as felts and battings, but spinnability has been improved to the extent that conventional knitted and woven fabrics are now available. Suits made from these fabrics have been demonstrated to be highly protective outer garments for firemen and race drivers.

A more recent candidate is a fire-retardant wool (treated with a chemical process called Proban) which meets many of the characteristics desirable for aircraft and other vehicle interiors. This material does not burn in air, is available in a wide range of colors, and can be considered for any application in which wool is a potential candidate. A similar process, called THPC, is used to impart fire-retardant qualities to cotton and cotton-based fabrics.

For purposes of completeness, several materials that are used in the spacecraft but are not presently considered for domestic applications are discussed briefly. Polybenzimidazole is an excellent fabric from almost every point of view, including nonflammability, but it is presently comparatively expensive. Teflon fabric is nonflammable, but has unsatisfactory drape and low tensile strength. Metallic fibers are expensive and lack durability. A new fabric from German Enka closely simulates cotton and is nonflammable, but as yet, is available only in experimental quantities.

Nonflammable Paper and Paperboard

A cellulosic material, developed by the Scheufelen Paper Company of Germany and processed primarily as a paper, carbonizes in the presence of a flame but does not propagate the flame. This nonflammable characteristic is evident both in air and oxygen-enriched atmospheres. This paper lends itself well to printing and, with some minor exceptions, has physical properties that are comparable to conventional paper.

This paper can be processed into a continuous roll of 0.5 inch thick foam, similar to papier-mache. When placed on a ceiling, for example, the foam has both the appearance and function of conventional acoustic tile and offers the additional advantage of nonflammability.

In addition to the Scheufelen paper, a process called Laminite which treats cellulose-base fiberboard with ammonium aluminum sulfate has been evolved. The resultant material is minimally flammable in oxygen and nonflammable in air. It can be formed wet, coated, cemented, and joined like a composite; yet, it is lightweight and inexpensive.

Elastomers

Elastomers developed for the space program are fluorocarbons, basically copolymers of hexafluoropropene and vinylidene fluoride. Although the elastomers are themselves minimally flammable, through the judicious use of compounding ingredients and plasticizers, nonflammability and a wide range of physical properties has been achieved. Notable among these elastomers are Fluorel (developed by the Minnesota Mining and Manufacturing Company and available from the Mosites Rubber Company and Raybestos-Manhattan Incorporated) and Viton (developed by E. I. duPont de Nemours and Company (Du Pont)). The compounded elastomers can be foamed, cast, molded, or extruded. The materials can also be applied as a paste, a coating, or a spray solution.

Mineral pigments in a wide variety of colors can be formulated into fluorocarbon-based paints. Panels fashioned of elastomer-backed nonflammable paper, to which decorative patterns have been applied, have been manufactured. The inclusion of asbestos in the backing provides insulating properties. Such a lightweight, fireproof sandwich affords much flexibility in decorative panel design. Elastomeric coatings can be applied to polyurethane foams and to cellulosic materials such as paper, wood, and sponge, thereby effectively fireproofing the materials for structural and insulative applications.

The capability for coating or replacing electrical components and accessories with Fluorel has been developed and has been used to some extent in the space program. The material can be molded to form wire ties, conduits, circuit breakers, and electrical connectors. When mixed with asbestos for increased nonflammability in oxygen atmospheres, the Fluorel can be applied as a conformal coating over electrical parts, presenting a firebreak in case of ignition from electrical sources.

Foams

There has been much activity in the area of nonflammable insulating foams. An asbestos foam has been developed by the Rex Asbestos Works of Germany. This material is marketed in batting and sheets, is inexpensive, and should be useful for general insulation applications.

The Monsanto Corporation has developed a polyimide foam; however, it is considerably more expensive than asbestos. The Scott Paper Company developed Pyrelle foam, a polyurethane with good weight-to-thickness ratio. This material is also inexpensive and commercially available. They have recently improved upon this product with a "Super-Pyrelle" which exhibits improved nonflammable properties, while retaining good physical characteristics.

A definite need exists for an insulation material which can be foamed in place. The Avco Corporation has developed, under NASA contract, an isocyanurate foam which is nonflammable in air atmospheres. Although easy to apply, this material is, at the present time, expensive. The Ventron Corporation has developed a glucose-based polymer which can also be foamed in place, which is self-extinguishing in air, and which is extremely low in cost.

The DuPont Company is developing a high resiliency polyurethane foam which can be foamed in place, and which is nonflammable in air. Potential for use of this foam looks good. This company has also developed a polyimide and mica paper-like material which foams and forms a hard char when heated. This material may have application for sealing metallic ruptures in the event of an externally caused fire.

Plastics

For replacements in areas where molded plastics are used, NASA, in conjunction with industrial sources, has developed a number of nonflammable substitutes. The Whittaker Corporation has developed a nonflammable polyquinoxalate, and North American Rockwell has developed a polyimide with Du Pont. These materials are at the present time expensive; however, as the more obvious applications are exploited, the cost should become more competitive with commercially available plastics.

Specific Applications

While these are the more promising candidates, they are by no means all of the materials which can be used to coat or replace flammable components. Additional materials and new and advanced technology become available every day. Working with these materials, we at NASA, in conjunction with a number of leading material and coating manufacturers, have developed methods and material combinations keyed to specific flameproofing applications.

Ceiling and Wall Panels

Existing ceiling and wall panels have been coated with Fluorel-impregnated fiberglass, with an overlay coating of transparent Kel-F applied for soil and stain resistance. The Fluorel surface can be furnished in an array of decorative designs. Panel backs have been coated with a mixture of 75 percent Fluorel/25 percent asbestos to prevent heat transfer as well as to provide fire protection.

This technique is applicable to wall and ceiling panels of all types; although, in the interest of expediency, it is believed to be more practical to supply the Fluorel/fiberglass/Kel-F combination for direct adhesive application to the panels. Pigmented Fluorel can also be applied directly to existing panels as a paint to provide fire-proofing qualities to interior wall surfaces.

Another approach is the replacement of existing ceiling panels with new panels, fabricated completely from nonflammable materials. To achieve this end, we are taking two approaches--corrugated boards and a honeycombed composite structure.

The Laminite Corporation is involved in the development of a nonflammable corrugated board. The feasibility of this approach has been demonstrated and we, together with Laminite, are presently working toward improving the physical characteristics, including weight reduction. We are also experimenting with a number of different techniques for applying a decorative finish to the panel surface.

The Hexcel Corporation has been concerned with the development of a nonflammable honeycomb structure. This honeycomb will be sandwiched between two nonflammable "skins," with the exterior skin surface decorated and protected against soil and staining. A number of candidate materials, such as fiberglass Nomex, and aluminum are being considered for honeycombing to achieve optimum physical properties. We are striving for the ultimate in panel construction, seeking panels which are light in weight, insulative, nonflammable, and exhibiting good strength, durability, and acoustical properties.

Interior Furnishings

NASA has developed a 20-mil Fluorel sheet, backed with Durette knit, to simulate a leather-like finish. This material can be made porous by a special process called "poralating" to impart "breathe" qualities to the material. This material is completely nonflammable, durable, and available in almost any desired color. It is intended for such uses as fabricating chairs, headboards, toilet kits, back covers, or in any other area where leather or naugahyde-like materials are used.

To fill the need for upholstery fabric, a number of airlines have switched to Proban-treated woolens. This treatment does not adversely affect the wool, but enables the treated woolens to meet Federal Aviation Agency flammability regulations. This material, available in a wide array of decorator colors and weaves, has equal application for any interior refurbishment. In addition to the wool, any of the treated fabrics, such as Durette and Fypro, are available in weights and weaves such as to make them likely candidates for upholstery fabrics. To illustrate such an application, the Monsanto Company, supplier of the Durette processed fabric, has refurbished an Aero Commanded aircraft with golden Durette fabric. This material was used to replace upholster curtains, and baggage-compartment liners. Durette wears well and is available in plushes, brocades, and sculptured patterns as well as in conventional knits and weaves.

Polyurethane chair and sofa cushions can be fireproofed by spraying the foam with Fluorel. This process is relatively inexpensive, costing only about a dollar a cushion for processing. Such a cushion, further protected with nonflammable upholstery, armrests, and headers, will eliminate one particular area in which fires can begin or propagate. Mattresses present an even greater fire hazard. This same processing can be used for fireproofing foam mattresses.

Nonflammable blankets can be made from Kynol, Fypro, or Durette batting, quilted to covers of Fypro or Durette. Pillows can also be fabricated of Kynol, Durette, or Fypro battings, or from treated polyurethane foam. Pillow cases can be made from THPC-treated cotton. The use of these items with nonflammable mattresses and chairs can eliminate another fire-hazard category, particularly when applied to institutions and homes in which patients are bedridden.

Curtains and draperies can be readily, and in many instances inexpensively, fabricated from fire-retardant fabrics. In addition to utilizing those fabrics discussed as candidates for upholstering, fiberglass and fire-retardant nylons, in a wide range of colors and weaves, can be fabricated into extremely attractive window coverings.

Another development in nonflammable composites that can be cited as a definite advance toward fireproofing structural interiors has been fabricated. This nonflammable layup, when used as a curtain, provides a firebreak against flame propagation from one interior area to another.

This curtain material is composed of three layers: Durette batting sandwiched between two layers of Fluorel-coated Durette. These fabrics are either quilted together or edge sewn, weigh approximately 1 lb/sq yard, and drape beautifully. Use of this layup as a fire break between utility and habitable areas of aircraft, institutions, nursing homes, and hospitals can be easily envisioned. The curtain could also be used to block off any hazardous or fire-prone areas, thereby providing safer passage for evacuees and preventing the spread of fire to occupied areas.

The nonflammable plastic substitutes can be molded into nonflammable trays, panels, medicinal bottles, light fixtures, utensils, physical therapy equipment, chairs, and wastebaskets, as well as cabinets and countertops.

Floor Coverings

Nonflammable carpet material has presented somewhat of a challenge. The best developed to date is 100 percent wool with a fire-retardant latex backing. American Enka has developed a fire-retardant rayon that can be fabricated into carpet materials which looks promising. NASA is presently investigating methods of spraying carpet backs with Fluorel, but this will be a relatively expensive process.

Among the more promising efforts underway is an attempt to adapt the Proban treatment to wool carpets. This adaptation has been successful with wool shag rugs, but sufficient THPC penetration into the carpet pile to achieve nonflammability has not been accomplished so far.

Fluorel can be molded and cut into nonflammable floor tiles, which are durable and comfortable underfoot. Metallic flock or particles (up to 50 percent by weight) can be used as a filler for the tile material, both to reduce the cost and to provide aesthetic appeal. These tiles have potential for use in heavily traveled or habitable areas or in locales where a fire hazard exists.

The use of rubber or vinyl matting as a floor covering can present a hazard during a fire. Nonflammable Fluorel can also be calendered or molded into mats of varying thicknesses and supplied in a variety of colors. Fiberglass laminated onto the back of the mat decreases the cost and provides better tear strength and durability. Treads can be molded into the Fluorel surface for areas where slippage would present a hazard. Such mats are not only nonflammable, but protect flammable floor materials against flame propagation. This same and extremely versatile material can be also used as a substitute for rubber in such applications as balls, shower curtains, exercise devices, restraints, and surgical gloves.

Paper Products

The multiplicity of functions performed by paper of all kinds in aircraft, commercial and industrial buildings, residences, hospitals, institutions of all types, and nursing homes is obvious. Nonflammable paper can substitute for a large majority of these applications. Available in a wide variety of thicknesses and colors, this paper can replace flammable writing paper, maps, legal documents, charts, towels, tray covers, paper cups, headrests, napkins, and trash liners. Even books, brochures, and magazines can be printed on this nonflammable paper.

Nonflammable paper can also be printed or embossed to produce a variety of designs, which should make it useful for such items as wall paper and lamp shades.

One particularly interesting area is the use of nonflammable paper and board for fabricating educational and recreational equipment. Work has been done in duplicating such items as playing cards, commercial games, and playroom equipment. These items are presently planned for use in the Skylab Program, but should also have particular use in the types of applications under discussion.

Nonflammable paper can also be used effectively to fabricate disposable clothing and footwear for hospital, industrial, and institutional staff members and attendants. More durable clothing can be fabricated from nonflammable fabrics; however, the expense involved would tend to obviate their disposable function.

Protective Clothing

The applications for clothing designed to protect personnel required to work or operate in hazardous or fire-prone areas span every industry and service, and are of concern to every citizen. From the racing driver to the steel worker, from the astronaut to the fireman, all must be, as we must be, concerned with personal safety. Protection of the man has been the prime impetus behind nonflammable materials development for the space program; our astronauts "blast-off" in nonflammable spacesuits. When the suits are removed inflight, they don coveralls of Teflon fabric, essentially nonflammable in an oxygen atmosphere.

We have fabricated gloves, shoes, underclothing, coveralls, helmets, shirts, and indeed clothing of all descriptions and from every available fabric in an effort to determine the optimum fire protection for all such applications.

NASA-Sponsored Firesuit Program

A brief description of our firesuit fabrication program will serve to illustrate the type of effort involved and point up criteria for materials selection.

It was decided to concentrate on two types of protective firefighters clothing--structural and proximity. Structural clothing may be defined as that normally worn by personnel engaged in firefighting activities. It is designed to be protective in nature, including safeguards against temperature extremes, possible exposure to sparks, flashing and embers, steam or hot water, sharp objects, abrasion and other hazards encountered during fires and emergencies.

Proximity clothing is designed to protect personnel from radiant heat as may be encountered when working close to extremely hot fires.

Should rescue of personnel be required, this suit may have to withstand intermittent exposure to direct flames.

To properly evaluate a choice of materials for the various suit layers, we designed and fabricated two types of both the structural and proximity suits. The first structural type consisted of a strong durable Durette outer layer, a Fluorel-coated Durette vapor barrier, and a detachable inner insulative liner. The second type consisted of a combined Fluorel-coated vapor barrier/Durette fabric outer layer, a second protective nonflammable layer, and again, a detachable insulative liner. The insulative liner is made up of two layers of Fypro and a layer of Durette batting. The first proximity suit consisted of an aluminized Durette outer layer, a Fluorel-coated Durette vapor barrier, Durette insulation, and a Fypro fabric liner. The second type is aluminized asbestos, backed with a coating of Fluorel to act as a vapor barrier. This suit also incorporates insulative materials for thermal comfort.

In accordance with recommended manufacturing practices, we incorporated abrasion patches on the shoulders and yokes of the structural firefighters suits; we used strips of reflective tape for visibility; a pocket was incorporated onto the upper right chest sized to contain an air mask; two box-type pockets were integrated onto the left and right sides of the coat front, and each jacket has a turn-up collar for face and neck protection. Two inch wide Velcro is used to secure the jackets.

In addition to the basic firefighting clothing, we have also designed several types of clothing not heretofore known in the firefighting industry. One concept consists of a pair of nonflammable Durette coveralls intended to be worn as off-duty clothing. In the event of a fire call, a pair of nonflammable insulative "chaps" are donned quickly over the legs of the coveralls. The structural firefighters coat completes the ensemble. Another coverall concept designed and fabricated by NASA is completely lined, nonflammable, and can be quickly donned in emergencies.

To illustrate another approach, we designed and fabricated nonflammable thermal underwear which can be worn in cold climates under regular clothing when fire protection is required.

In the area of ancillary clothing, we have fabricated nonflammable overboots, gloves, mittens, and a protective cap to be worn over the head and under a standard firefighter's helmet. We have also designed a proximity suit hood which incorporates a protective visor, pairs of proximity gloves, and aluminized overboots. In addition to this fabrication, we have on the drawing board, plans to fabricate standard firefighters hard boots from nonflammable materials. We also intend to mold helmets from nonflammable plastics.

Naturally, one of our greatest concerns in the fabrication of these suits was to make sure that we had a functional design; one which would perform as well or better than conventional gear. To accomplish this goal, we have worked very closely with both the Houston Fire Department and representatives of the International Association of Firefighters. We have also worked with the National Bureau of Standards and with other industrial and government groups interested in this problem of providing better protective clothing for this nation's firefighters.

Members of the Houston Fire Department have been wearing these garments during their normal firefighting activities on a daily basis for over five months now, and the response from the individual firemen has been extremely enthusiastic. The garments were adjudged to be extremely functional, and with minor changes, many of which are individual preferences, the designs are pretty well firmed up. The firemen wearing the structural suits have developed such confidence in their protective qualities that they are approaching closer and closer to the fire, the distance restricted only by a lack of face protection.

A more dramatic illustration of the protective qualities of these garments has been provided by a series of tests conducted by the Houston Fire Department Training Institute. In these tests, pit fires, utilizing various types of fuel, have been extinguished by firemen wearing

NASA's firefighting clothing. We have photographic coverage which amply demonstrates the protection afforded the firemen wearing these garments.

These garments were demonstrated at the Firefighters Symposium held at Notre Dame University and attended by firefighters from all over the United States and Canada. They have also been the subject of several journal articles receiving wide distribution among firemen and concerned industrial personnel.

Response has been extremely enthusiastic; we have received more than 100 inquiries requesting information and inclusion as test subjects in our test and evaluation program. We are proceeding with a small scale procurement of garments for evaluation at selected test sites throughout the country. The ultimate aim of this evaluation study is a specification for the design and fabrication of improved firefighters clothing, based on the use of nonflammable or fire-retardant materials in their construction.

NASA Housing Module Test Program

To demonstrate the many possibilities for use of these materials in the building and interior furnishings industries, we have constructed five miniature housing modules to be used in a controlled flammability test program. Each module will be constructed and selectively furnished so that instrumented comparisons can be made between the variety of these new fire-retardant materials.

Promising nonflammable materials will be used for roofing, side panels, flooring, insulation, carpets, paints, and curtains. Flammability test sequences will involve the use of realistic ignitors and fuels located in predetermined areas, with full photographic coverage to be made available to the building industry.

NASA Aircraft Refurbishment

Another area of application of these technological advances is the aircraft industry. We assisted the Air Force in refurbishing two T-39 aircrafts and are ourselves refurbishing one NASA Gulfstream aircraft.

Two MSC personnel, working on-site in Winnepeg, Canada, helped to accomplish part of the T-39 effort, and while there, trained personnel to complete the refurbishment.

To fireproof the T-39 ceiling panels, a Fluorel/fiberglass/Kel-F skin was laminated to the existing wooden panels. Kick panels were completely replaced by a Pyrelle foam/fiberglass/decorative Fluorel/ Kel-F composite.

All seat cushions were fireproofed with ammonium dihydrogen phosphate (ADP) and Fluorel spray. The seats are now being upholstered with THPC-treated fabrics. Armrests were covered with Fluorel-coated Durette, simulating naugahyde, and seat side panels were protected with Fluorel-based paint.

The fiberglass curtains were installed, and wool carpets were installed in the passenger compartment. Fluorel-coated fiberglass matting was used as a nonflammable floor covering in the vestibule area and on the outside stairs leading into the aircraft. Deep treads have been molded into the Fluorel surface to assure good traction.

Refurbishment of the Gulfstream follows the same general philosophy, but utilizes several different materials in a more extensive refurbishment, taking advantage of more advanced fabrication techniques.

The Gulfstream walls and ceilings presently are covered with a vinyl fabric. All of this covering will be stripped and new nonflammable fabrics developed especially for this program substituted. The new headliner fabric will be a Fluorel-coated fiberglass, off-white, and textured. The walls will be covered with Fluorel-coated Durette fabric, backed with a thin Pyrell foam padding.

All seats within the aircraft will be completely redone; flotation cushions will be fabricated and fireproofed, new upholstery installed, arm rests and foot rests recovered, nonflammable head rests fabricated, and seat bottom shrouds painted with Fluorel.

All curtains will be replaced with curtains fabricated from nonflammable fabrics. The firebreak curtains discussed earlier will be used at the entryway to the aircraft. The naugahyde simulating Fluorel-coated Durette will be used to fabricate a curtain protecting the area where the hydraulics are stored. The other curtains are standard, with the exception of the nonflammable fabrics used in their construction.

All existing floor coverings will be replaced, including the padding. Wool carpeting over fireproofed padding will be used in the passemger area, and a Fluorel-coated fiberglass with treads molded onto the surface will be used to replace the present vinyl floor covering in the vestibule area.

All of these materials have been developed, evaluated for feasibility of installation and fabrication, color-keyed to the aircraft decor, procured, and delivered ready for installation.

In addition to these programs, MSC has available on-site a United Airlines 737 fuselage which will be used to conduct an aircraft flammability test program. This program will be similar to, though on a somewhat larger scale, the housing module test in that the fuselage will be sectioned according to a predetermined plan, refurbished with nonflammable materials varying by compartment and test location, instrumented and artificially ignited. Again, results of these tests, with full photographic coverage, will be made available to the aircraft industry.

Concluding Remarks

From the foregoing discussion, it is obvious that almost any conceivable construction, furnishing, clothing, or utility device can be fabricated from metallic or nonflammable nonmetallic materials. Starting with this positive approach, such factors as commercial availability, wear and aesthetic qualities are no problem. Cost primarily becomes the only limiting factor in achievement of safety.

An additional word for those of you interested in detail of what I've discussed only briefly, we have the following reports available: a 3" volume called "Comat," plus brochures, specifications and instructions for processing, as well as a source list of everything I've discussed. If you desire any of the material, contact WESRAC, and they will in turn call me if necessary and/or will contact the cognizant service center involved to supply you with the information you desire.