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AN 8970 dated 2

TO: Distribution

FROM: Peter Lloyd, Geon Vinyl Division.

DATE: 2.23.1993

SUBJECT: TEN LIES ABOUT PVC - AND THE TRUTH

Bob

I thought you would be interested to have a copy of this in your files for future reference.

This document addresses the ten most frequent challenges to PVC at three levels of complexity.

1. A short, concise rebuttal.
2. A more fully argued rebuttal, addressing the issues in more depth. but avoiding scientific jargon.
3. As item 2, but including the latest status on the validity of the global warming and ozone depletion issues.

A reference list is provided to back up the more controversial statements.

The document can be used as it stands, in any of its three versions, or information can be extracted from it for more focussed rebuttals.

The short version is a basis for an even shorter but more punchy folder, with two or three lines only on each issue, without references. A note could be included offering more complete information (i.e., one of the longer versions) if needed.

Unfortunately I have not had enough time to complete a draft for the folder before my departure.

Peter Lloyd

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TEN LIES ABOUT PVC

- AND THE TRUTH

(SHORT VERSION)

BF GOODRICH COMPANY

PETER LLOYD

JANUARY 18th. 1993

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TEN LIES ABOUT PVC - AND THE TRUTH

1. THE MANUFACTURE AND USE OF PVC IS A MAJOR TOXIC HAZARD BECAUSE IT IS MADE FROM CHLORINE, A POISONOUS GAS WHICH DOES NOT EXIST IN NATURE.

FALSE.

Chlorine is the twentieth most abundant element in the universe and on our planet. It is 0.013% of our Earth's crust and almost 2% of our oceans. It is part of hundreds of natural chemicals which are essential to life (7), and to the functioning of the human body, of which it makes up about 0.15%. Chlorine, like many other elements which are essential to life, such as sodium, potassium and calcium, is very reactive and corrosive. As soon as it appears in its elemental form as a gas, it quickly joins with other elements to form chlorinated compounds.

Chlorine gas is toxic in sufficient concentration, but so are nitrogen and even oxygen. All three are essential to life but toxic in sufficiently high doses. There is absolutely no free chlorine in PVC. Chlorine is a valuable environmental resource because it is virtually inexhaustible and can be used for thousands of useful products. It can be extracted with less energy expenditure than many other common raw materials, and products based on it replace products made from petroleum, trees and metals.

2. PVC IS CARCINOGENIC BECAUSE IT IS MADE FROM VINYL CHLORIDE, A KNOWN CARCINOGEN, AND CONTAINS PLASTICIZERS WHICH ARE ALSO CARCINOGENS.

FALSE. PVC is biologically inert, is not metabolized when ingested, implanted or inhaled as dust, and is not carcinogenic (1,2).

In the early 1970s, it was discovered that regular inhalation over many years of high concentrations of vinyl chloride monomer (VCM) caused angiosarcoma, a liver cancer. New manufacturing technology and workplace exposure rules were immediately instituted. Since then, no worker who has worked only under the new rules, worldwide, has contracted angiosarcoma (11). The traces of residual VCM which remain in PVC products are in the parts per billion range, so the potential human exposure is millions of times less than the permitted workplace exposure amounts known NOT to cause cancer. VCM does not cause other forms of cancer (17).

The most common PVC plasticizer, DOP (also known as DEHP) was at one time alleged to be a carcinogen, but after an extensive international scientific investigation it proved not to be so, and to provide no danger of food contamination (5,6). Another PVC plasticizer commonly used in food wrap film, DOA (also known as DEHA), was similarly challenged and eventually shown to be safe (16).

3. THE MANUFACTURE OF PVC AND ITS RAW MATERIALS PRODUCES DANGEROUSLY LARGE AMOUNTS OF TOXIC WASTES AND EMISSIONS.

FALSE. In all modern industrialized countries, chemical plants for the manufacture of chlorine, ethylene dichloride (EDC), vinyl chloride monomer (VCM) and PVC are controlled by government regulatory bodies which set strict limits on workplace exposures, emissions and wastes to reduce them to levels well below those known to be safe. Most plants work to even lower limits to ensure compliance and for productive efficiency. Plants are operated by professional engineers who would not work in them or live near them if they were dangerous.

4. PVC PRODUCTION WASTES LARGE AMOUNTS OF ENERGY AND LIMITED RAW MATERIALS.

FALSE. PVC is one of the most highly energy and resource efficient structural materials in use today. The manufacture of PVC products requires less energy and limited natural resources than is needed to make the same products from any other plastic or from the traditional raw materials PVC has replaced, such as steel, glass, aluminum (8,12,13), rubber, copper, lead and paper.

PVC products have longer service lives than similar products made from traditional materials and use less energy throughout their long life. The replacement of traditional materials and other plastics by PVC is environmentally desirable (14), because it significantly reduces the use of limited raw materials like petroleum, trees and metals, and uses instead chlorine, a virtually inexhaustible resource that can be extracted with minimal environmental impact.

5. PVC IS A FIRE HAZARD AND PRODUCES DEADLY SUPERTOXIC FUMES WHEN IT IS BURNED.

FALSE. PVC is the only major thermoplastic material which does not burn by itself. It is inherently fire-safe, in contrast to all other low-cost plastics and the common organic materials of construction, furnishing and decoration - wood, paper, textiles, etc.

Flexible (plasticized) PVC contains plasticizers, most of which burn. Flexible PVC therefore burns more easily than rigid PVC, but still not as easily as other common plastics, which not only burn but drip flaming drops of molten plastic, so spreading the fire. Nor does it burn as easily as the traditional organic materials it has replaced, such as wood, paper and textile fibers. For critical fire safety applications, flexible PVC can be easily formulated with plasticizers which do not burn, producing a fire performance similar to rigid PVC.

The hydrogen chloride produced by PVC when it is burned is no more toxic than the carbon monoxide produced by wood, paper and textile fibers (9). No fire death has ever been caused by hydrogen chloride fumes.

All burning vegetable matter, as in forest fires and incinerated organic waste, produces harmless traces of dioxins. Burning fossil fuels in power stations and car exhausts are also major producers. Dioxins are

not nearly as toxic to humans as has been claimed, and they have been in the environment long before humans (18,19). The amount of dioxins produced by PVC in fires is trivial compared with natural sources.

6. PVC IS ENVIRONMENTALLY UNACCEPTABLE BECAUSE IT CANNOT BE RECYCLED, ITS PRESENCE PREVENTS OTHER PLASTICS FROM BEING RECYCLED, AND IT IS NOT BIODEGRADABLE.

FALSE. PVC is easily recycled, and has been routinely recycled within the industry for over thirty years. Moreover, since well over half of all PVC is used in construction, where products have a practical life of fifty years or more (e.g., pipes, wire and cable, window frames), large and readily available applications already exist for both rigid and flexible PVC which has been recycled from shorter lived applications, such as bottles or packaging.

The high cost of collecting and sorting is the key problem in recycling all materials. Because it is a chlorine compound, PVC is very easy to identify in the automated sorting machinery which is necessary to keep sorting costs down and make recycling economically viable.

If biodegradable plastics are recycled and mixed with conventional plastics, the bulk of the recycled product becomes biodegradable. This is catastrophic, because plastics are used mainly because they cannot corrode and so have a long service life. The fact that PVC never corrodes and is not biodegradable is a major environmental advantage in reducing energy costs and raw material consumption.

7. PVC WASTE CANNOT BE LANDFILLED BECAUSE IT LEACHES DEADLY TOXIC CHEMICALS INTO THE SOIL AND GROUNDWATER.

FALSE. PVC is not toxic and is practically inert in landfills. It is insoluble in water so that additives cannot be extracted at high enough rates and in sufficient quantities to be hazardous (3,4). In fact, flexible PVC membranes and rigid PVC pipes are used to line, cap and drain the latest types of regulated landfills because of their proven safety, impermeability and long life.

8. PVC WASTE CANNOT BE INCINERATED BECAUSE IT CORRODES INCINERATORS, PRODUCES ACID RAIN AND SUPERTOXIC DIOXINS.

FALSE. Thousands of tons of municipal solid waste containing PVC are incinerated without problems every day in Europe, the USA and Japan. The energy content of PVC can be recovered in waste-to-energy incinerators as easily and safely as other municipal solid waste (MSW).

All MSW produces corrosive hydrogen chloride when it is burned, whether PVC is present or not. MSW incinerators have always been designed for the highly corrosive conditions of all combustion, including the presence of hydrogen chloride among the many other acid gases produced by burning MSW. The incineration of MSW which contains PVC does not cause unique problems of dioxin formation, since MSW without PVC still produces dioxins when it burns (10).

Modern incinerators must be designed to reduce the emission of particulates, acid gases, dioxins and other unwanted products to low, regulated levels. Operation of these incinerators in conformance with regulations is mandatory, whether PVC is present in the waste or not, and incinerator technology works as well on the combustion products of PVC as it does on those of the other organic materials in MSW.

9. PVC CONTAMINATES THE ENVIRONMENT WITH DANGEROUS AMOUNTS OF TOXIC HEAVY METALS.

FALSE. Heavy metal additives are firmly bound within a rigid PVC matrix and it is physically impossible for them simply to diffuse out into the surroundings while the product is in normal use. PVC is insoluble in water, so that additives cannot be dissolved out of the bulk of a rigid PVC product in use or when it is disposed of in a landfill (3,4). There is thus no large-scale mechanism by which heavy metal additives in rigid PVC can escape into the environment, and from there be ingested, inhaled or absorbed by humans, so no pathway for toxic hazard exists.

Flexible PVC contains plasticizers, some of which may diffuse very slowly out of the PVC matrix, carrying small amounts of any heavy metal stabilizer present to the surface of the product, from which it may leached by water, fats and solvents. However, the rate at which this process operates is so low that there is no significant toxic hazard. For critical applications non-mobile plasticizers are used, in which case the diffusion and leaching behavior is more like that of rigid PVC.

Many PVC products, including food wrapping film, water bottles, medical tubing and blood bags, are formulated without using heavy metals. PVC compounders are reducing the use of heavy metal additives to absolutely essential applications.

10. PVC CONTRIBUTES TO GLOBAL WARMING AND OZONE LAYER DESTRUCTION.

FALSE. PVC is one of the most environmentally efficient materials, the use of which minimizes energy consumption and therefore the production of carbon dioxide.

Natural increases in atmospheric carbon dioxide have historically been several times larger than those due to human energy production from fossil fuels (15). Nevertheless, it is obviously desirable to reduce atmospheric pollution to a minimum. Making products out of PVC requires slightly less energy than making them from other common thermoplastics, and a lot less than making the same products from steel, aluminum, copper, and glass (8,12,13). Less energy production means less carbon dioxide produced from burning fossil fuels. The preferential use of PVC therefore reduces emissions of man-made carbon dioxide.

The ozone layer undergoes cyclic depletions at the poles which may be due to entirely natural causes, or to chlorinated compounds from industrial production. Traces of chlorinated compounds emitted from PVC plants are too short-lived to rise into the stratosphere in any significant quantity, and the amount of hydrogen chloride from PVC

burned in incinerators and accidental fires is quite insignificant compared with the huge amounts produced by burning vegetation, volcanos and the oceans. The production and use of PVC has, therefore, little or no effect on ozone depletion.

Peter Lloyd
BF Goodrich Company
January 18th. 1993

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FALSE.

Chlorine is the twentieth most abundant element in the universe and on our planet. It is 0.013% of our Earth's crust, almost 2% of our oceans, and part of hundreds of natural chemicals which are essential to life (7) and the functioning of the human body, of which it makes up about 0.15%.

Chlorine, like many other elements which are essential to life, such as sodium, potassium and calcium, is very corrosive and reactive. When it appears in its natural gaseous state, it quickly joins with other elements and compounds to form more stable chlorinated compounds. Chlorine gas is toxic in sufficient amounts, but so are nitrogen and even oxygen. All three, like hundreds of other natural chemicals, are essential to human life but toxic in sufficiently high doses.

There is a natural chlorine cycle in which water dissolves natural chlorine compounds from the rocks of the earth, and transports them to vegetation and into the oceans, in which they are changed into volatile organochlorines. Millions of tons of these natural organochlorines evaporate from the oceans into the atmosphere annually, from which chlorine compounds are washed out by rain and deposited once more in the soil and rocks of the earth. Natural chlorine compounds, from simple hydrochloric acid to dioxins and complex chlorinated alkaloids, are all around us in the environment.

Many chlorine compounds are essential to the chemistry of the human body, like vitamin B_1 and the chloroperoxidase enzymes which protect us against disease, toxins and tumors. Other chemicals made from chlorine are relatively inert and nontoxic. Examples are natural common salt, or sodium chloride, and man-made PVC, or polyvinyl chloride, which is even more inert and safer than salt because it does not dissolve in water or react with body fluids. There is absolutely no free chlorine in PVC.

Man-made chlorine and chlorinated compounds are made in chemical plants which, like all chemical plants, are subject to strict government controls and inspections to ensure safety, minimum emissions and nontoxic wastes.

Chlorine is a valuable environmental resource because it is virtually inexhaustible, and can be extracted with less energy than is needed for most other raw materials. Thousands of useful man-made products based on it replace products made entirely from limited resources like petroleum, trees and metals.

2. PVC IS CARCINOGENIC BECAUSE IT IS MADE FROM VINYL CHLORIDE, A KNOWN CARCINOGEN, AND CONTAINS PLASTICIZERS WHICH ARE ALSO CARCINOGENS.

FALSE.

PVC is insoluble in water and fats, cannot be metabolized, is biologically relatively inert, and is not an environmental hazard. It is completely nontoxic and noncarcinogenic when ingested (3). Most solid and powdered materials, including PVC, cause inflammation, fibrosis and various kinds of local tumors when implanted or inhaled, due to mechanical abrasion or the normal body's rejection mechanism. Implantation and inhalation tests on PVC have not provoked abnormally severe reactions or carcinogenic effects (1,2). PVC does not contain hazardous toxic organochlorines which can pollute the environment.

PVC is made from vinyl chloride monomer (VCM), a gas which may remain present in finished PVC products in residual trace amounts in the parts per billion range. VCM gas can cause human angiosarcoma, a particular form of liver cancer, but only when it is regularly inhaled over many years in high concentrations of thousands of parts per million and in amounts millions of times greater than the residual traces found in PVC products. The rate at which this infinitesimal trace of residual VCM can diffuse out of a PVC product in service is so low as to be undetectable by the most sensitive scientific instruments. Strict workplace VCM exposure limits were agreed in the mid-1970s, and the vinyl industry's carefully maintained worldwide health statistics record that no workers who have joined the industry in the eighteen years since then have contracted angiosarcoma (11).

VCM has been shown not to cause other cancers (17).

Potential exposure to VCM from PVC products is therefore millions of times less than the workplace limits, amounts known NOT to cause cancer.

Flexible PVC contains plasticizers to make it soft. Some years ago, the most common PVC plasticizer, DEHP, was attacked, principally by commercially competitive interests, on the grounds of carcinogenicity. DEHP-plasticized PVC has been used for over thirty years, throughout the world, to make flexible transparent bags for long-term storage of blood, plasma and saline solution. This application has the highest potential for direct introduction of PVC additives into the human body, and the products are always used under medical supervision. Nevertheless, in all that time, no case has ever been recorded of a medical problem caused by contamination of blood, plasma, or saline by the PVC storage bag. Over 3000 papers have been written reporting investigations into DEHP (5), and a major international scientific review (6) finally concluded that "...DEHP could not be classified as a carcinogen or as a teratogenic substance..." and that "...there is no risk to man due to contamination of food", (i.e., when DEHP-plasticized PVC film is used for food wrap).

Another common plasticizer for PVC, DOA, also known as DEHA, is often used for cling film and other food contact applications, especially in Europe. After extensive investigation by the British Ministry of Agriculture, Food and Fisheries, it was reported to be nontoxic and noncarcinogenic (16).

3. THE MANUFACTURE OF PVC AND ITS RAW MATERIALS PRODUCES DANGEROUSLY LARGE AMOUNTS OF TOXIC WASTES AND EMISSIONS.

FALSE.

In western countries, chemical plants for the manufacture of chlorine, ethylene dichloride (EDC), vinyl chloride monomer (VCM) and PVC are controlled by government regulatory bodies which set strict limits on workplace exposures, emissions and wastes to reduce them to levels well below those known to be safe. Regulatory controls vary from country to country, but usually require routine monitoring of atmosphere, waste water and groundwater in, and sometimes adjacent to, PVC plants. Most plants work to even lower limits to ensure compliance and for productive efficiency.

The EDC/VCM manufacturing process, in particular, is one of the most efficient in the chemical industry. Wastes and by-products are fed back into the process, so that material utilization is very close to 100% and waste products are at extremely low levels. The process is so highly developed that, unless the material balance is correct, it does not work technically, nor are the economics acceptable.

Chemical plants are operated by skilled, intelligent, conscientious professional engineers who work in the plant every day, and usually live nearby with their families. These people have the highest possible interest in running the plant safely and not contaminating their workplace or the immediate environment.

4. PVC PRODUCTION WASTES LARGE AMOUNTS OF ENERGY AND LIMITED RAW MATERIALS.

FALSE.

PVC is one of the most highly energy and resource efficient structural materials in use today. Making PVC products requires less energy and less of the limited natural resources than are needed to make the same products from any other plastic, or from the traditional raw materials PVC has replaced, such as steel, glass, aluminum (8,12,13), rubber, copper, lead and paper.

Because PVC is tough and never corrodes, PVC products usually have longer service lives than similar products made from traditional materials. Because PVC is strong, light and a good thermal insulator, PVC products save energy throughout their long life. The replacement of traditional materials and other plastics by PVC significantly reduces the use of petroleum, trees and metals as raw materials, and uses instead chlorine, a virtually inexhaustible resource.

Today, less than half of the manufacturing energy and hydrocarbon material needed for PVC comes from petroleum; the rest comes from the chlorine in salt water. If petroleum becomes too scarce or expensive as a source for PVC's hydrocarbon content, natural gas could be used, or renewable sources, such as low energy biological conversion of agricultural products or even of organic wastes. This is an important advantage, not only from a conservationist and environmental viewpoint, but also because it means that PVC will always be available at a reasonable cost, and so is an excellent material on which to base long-term environmental and resource planning.

PVC is a real environmentalist's material of choice, as was discovered by Bellona, a Norwegian environmental group which has been the only one to research the issues in depth rather than rely on an unthinking reflex response of emotional slogans (14). When Bellona researched a proposed ban on PVC for packaging, they came to the conclusion that the environment would suffer more if PVC were to be banned.

This ecobalance approach to assessing the environmental value of a raw material should be the basis for all environmental impact decisions, rather than public relations campaigns based on superficial and inaccurate data disguised as science. Unfortunately, ecobalance studies are difficult to do, take a long time, and the results are not as attention-grabbing as a startling but inaccurate news release based on an inadequate examination of the facts.

5. PVC IS A FIRE HAZARD AND PRODUCES DEADLY SUPERTOXIC FUMES WHEN IT IS BURNED.

FALSE.

Rigid PVC is the only major thermoplastic material which does not burn by itself. It is inherently fire-safe, in contrast to all other low-cost plastics, and all the common organic materials of construction, furnishing and decoration - wood, paper, textiles, etc. It can only be made to burn by keeping it in a flame fed from some other burning material. When the flame is removed, rigid PVC self-extinguishes. It has a higher ignition point than other common plastics and organic materials, and requires more oxygen to start and maintain burning.

Flexible PVC contains plasticizers, and most of the common plasticizers burn. Flexible PVC therefore burns more easily than rigid PVC, but still not as easily as other thermoplastics, some of which not only burn but drip flaming drops of molten plastic, so spreading the fire. Nor does flexible PVC burn as easily as the traditional organic materials it replaces, such as paper and textiles. For applications in which fire safety is critical, flexible PVC can be easily formulated with plasticizers which do not burn.

When it is made to burn, PVC gives off hydrogen chloride fumes, but the toxicity of hydrogen chloride is about the same as that of carbon monoxide, which is given off by all burning organic materials. Primates can breathe 15,000 parts per million (ppm) hydrogen chloride for 15 minutes, with some discomfort, but no adverse long term effects (9). Indeed, the strong acrid smell of hydrogen chloride can be detected at a concentration of less than 1 ppm, making it a safe and useful early warning of a fire.

For very critical fire safety applications, both rigid and flexible PVC can be formulated to reduce combustibility, heat loss, smoke and acid gas emission still less, even to the very low values typical of advanced fire safe materials.

No fire death has ever been attributed to hydrogen chloride. When PVC is made to burn, the fumes are no more toxic than those of any other burning organic material. PVC is the answer to many fire safety problems.

Claims that when PVC is burned it produces large amounts of deadly dioxins are equally untrue. Wood, textiles, paper, vegetable waste, agricultural and forest fires and all organic materials produce minute traces of dioxins when they are burned. In accidental fires, the amount of PVC in a building is very small in comparison with these natural structural and decorative materials, and any dioxin due to PVC is therefore a tiny proportion of a very small total.

Humans have always been exposed to dioxins from natural fires and our bodies are adapted to them. Contrary to the wide publicity over the last few years, dioxins are not unusually toxic to human beings (18). A small number of accidental mass overexposures have demonstrated distressing but curable chloracne immediately on contact, but no long-term toxicity or carcinogenicity (18,19).

8. PVC WASTE CANNOT BE INCINERATED BECAUSE IT CORRODES INCINERATORS, PRODUCES ACID RAIN AND SUPERTOXIC DIOXINS.

FALSE.

Thousands of tons of municipal solid waste (MSW) containing PVC are incinerated without problems every day in Europe, Japan and the USA, increasingly with waste-to-energy conversion. All modern incinerators in these countries must meet strict pollution control regulations, and older incinerators are often being retrofitted with pollution control devices enabling them to meet modern regulations. PVC is incinerated and its energy content recovered in waste-to-energy incinerators as easily and safely as other MSW.

PVC is only one of many sources of corrosive hydrogen chloride produced by MSW incineration, the rest coming from the burning of vegetable and other organic wastes, other natural and synthetic chlorinated hydrocarbons, and the salt always present in MSW. Incineration also produces other highly corrosive gases, such as the oxides of sulphur and of nitrogen. Even the simple combination of intense heat and water vapor is highly corrosive.

Corrosion in an incinerator is therefore not a new problem, nor is it a problem due solely to the presence of PVC. MSW incinerators have always been designed to withstand the highly corrosive conditions of all combustion, whether PVC is present or not.

Acid rain is caused by the absorption of atmospheric natural and man-made oxides of sulphur and nitrogen, and hydrogen chloride. Of the man-made acid gases, only about 2% is hydrogen chloride, of which the majority comes from electrical generating stations. Modern incinerators and waste-to-energy recovery plants are regulated. They must be fitted with pollution control devices to absorb acid gases, whether or not PVC is present in the waste. The incineration of PVC is, therefore, not a significant contributor to the acid rain problem.

Dioxins are produced in trace quantities whenever salt and other natural or synthetic chlorinated compounds are burned. Natural forest and vegetation fires are relatively large producers. Car exhausts, coal and oil-fired power stations, as well as MSW incinerators, all produce traces of dioxins. Full scale scientific investigations in the USA, Holland, Sweden, and Italy have shown that the amount of dioxins produced by MSW incineration has no connection with the presence or absence of PVC, but is determined by operating conditions, principally combustion and flue gas temperatures (10). The amount of dioxin produced in all the examples given above are so infinitesimal as to represent no human hazard whatsoever.

Although dioxins are certainly toxic, their toxicity has been greatly exaggerated, and in fact they are not exceptionally toxic to humans. Humans have always been exposed to traces of dioxin in the environment from natural sources, and our bodies are adapted to this background level (18,19).

9. PVC CONTAMINATES THE ENVIRONMENT WITH DANGEROUS AMOUNTS OF TOXIC HEAVY METALS.

FALSE.

In some applications for PVC, heavy metal stabilizers and pigments are needed to give unique and necessary properties such as outstanding processing stability, maximum resistance to weathering, maximum electrical insulation, maximum color hold or sparkling transparency. Without being regulated, PVC compounders are reducing the use of heavy metals to applications where these properties are absolutely essential.

Many large volume PVC products, including food wrapping film, water bottles, medical tubing and blood bags, are formulated without using any heavy metals at all.

When they are used, heavy metal additives are firmly bound within a rigid PVC matrix and it is physically impossible for them simply to diffuse out into the surrounding atmosphere while the product is in normal use. Rigid PVC is insoluble in water, so that additives cannot be dissolved out of the bulk of a rigid PVC product in use. There is thus no large-scale mechanism by which heavy metal additives in rigid PVC products can escape into the environment, and from there be ingested, inhaled or absorbed by humans to any significant extent, so no significant pathway for toxic hazard exists (3,4).

Flexible PVC contains plasticizers, some of which may diffuse very slowly out of the PVC matrix, carrying small amounts of any heavy metal stabilizer present to the surface of the product, from which it may be leached by water, fats and solvents. However, the rate at which this process operates is so low that there is no significant toxic hazard. For critical applications, low volatility plasticizers are used, in which case the diffusion and leaching behavior is more like that of rigid PVC.

Lead stabilizers are widely used outside the USA for rigid PVC potable water, waste and sewage pipes, rainwater gutters, window profiles, wire and cable insulation, and other construction applications. PVC potable water pipe is the only one which offers a potential direct pathway for human ingestion of dissolved lead. It is made under strict regulatory control to verify that any dissolved lead is below regulatory limits, which are themselves well below concentrations known to be safe. The fact that lead stabilizers cannot be extracted from rigid PVC by water is convincingly demonstrated by the hundreds of tests carried out by research organizations and regulatory bodies on PVC pipe for drinking water. When water in the pipe is analyzed, no lead extraction can be detected after the traces in the initial surface film are washed off (3).

10. PVC CONTRIBUTES TO GLOBAL WARMING AND OZONE LAYER DESTRUCTION.

FALSE.

PVC is part of the solution to global warming and has little or no effect on ozone depletion. It is one of today's most environmentally effective materials because of its low consumption of petroleum and energy. The continued and increased use of PVC instead of traditional materials and other plastics reduces carbon dioxide production and other forms of atmospheric pollution.

The production of energy in power stations and vehicles by burning oil, gas, coal and petrol is inevitably accompanied by the production of massive amounts of carbon dioxide and other atmospheric pollutants. Although natural increases in carbon dioxide have historically been several times larger than those due to human energy production from fossil fuels (15), it is clearly in our long-term interest to reduce energy consumption, and therefore atmospheric pollution, to a minimum. This can only be done by the long-term planning of our choice and use of energy resources needed for the future of modern society.

Making PVC and PVC products requires less energy than that needed for the majority of materials and products which PVC has replaced, e.g., iron, steel, aluminum, glass. Making PVC needs even less energy than making other common plastics (8,12,13). Using PVC reduces energy demand, so that less carbon dioxide is released into the atmosphere by power generating stations.

Using PVC instead of these traditional materials has even greater benefits if the energy savings of the end products in use are considered. For instance, PVC in vehicles, and PVC bottles for shipping liquids, reduces weight and lowers energy consumption and exhaust pollution per mile. PVC pipes for water supply are much lighter than cast iron, need less energy to transport to site, and the smoother walls result in less pumping energy for the whole life of the system - probably well over fifty years. PVC window frames are naturally better thermal insulators than aluminum and last longer than wood, in both cases resulting in less energy use over a long service life.

PVC products which have served their useful life, but are too contaminated to recycle, can be incinerated with energy recovery for maximum energy efficiency. The fact that only 43% of PVC is hydrocarbon means that incineration will produce only about half of the amount of carbon dioxide as wholly organic materials, such as wood, paper, textiles and other plastics. Even in final disposal, PVC reduces the burden on the atmosphere.

The large-scale replacement of wood and paper by PVC in many applications helps to preserve forests, which are huge natural absorbers of atmospheric carbon dioxide.

Although a cyclic annual pattern of polar ozone layer depletion has only been observed for a very few years, it is commonly believed to be due to synthetic long-lived chlorofluorocarbons (CFCs) in the atmosphere, to the extent that many Governments have taken action to ban them. PVC does not contain significant amounts of volatile organochlorines and

cannot contribute to this problem.

Traces of organochlorines released during the manufacture of chlorine, EDC, VCM and PVC are not nearly enough to account for observed ozone depletion, and in any case they are short-lived, rapidly degraded by a combination of sunlight, atmospheric oxygen and moisture. Moreover, emissions of synthetic organochlorines are constantly decreasing as manufacturing technology improves. Many major PVC manufacturers have reduced emissions by over 90% over the past twenty years. USA manufacturers are committed to the Responsible Care ™ program of the Chemical Manufacturers Association, which has a long-term goal of developing zero emission technology.

PVC therefore makes little, if any, contribution to depletion of the ozone layer.

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BF Goodrich Company
January 15th. 1993.

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