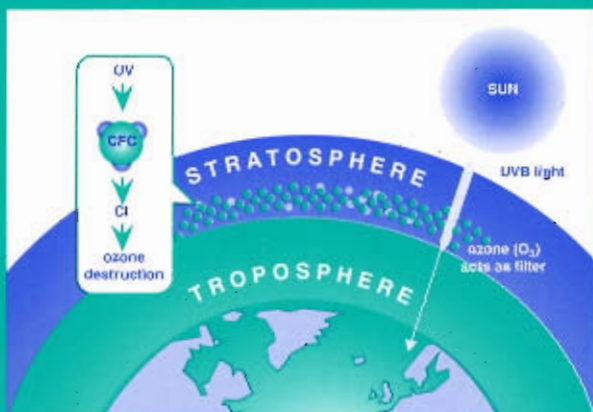


## A WORLD OF ENVIRONMENTAL BENEFITS

### Recyclable

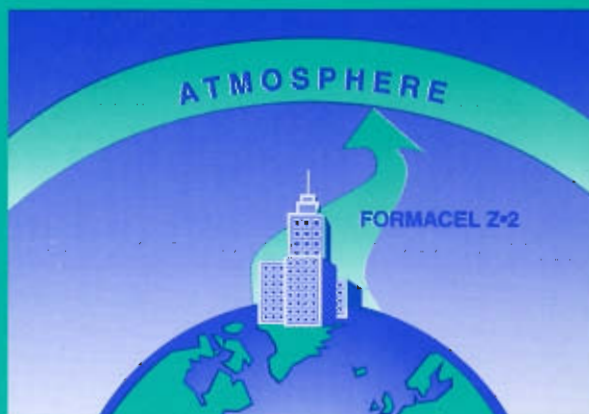
Packaging made with FORMACEL Z•2 is recyclable.

### Zero Ozone Depletion Potential (ODP)

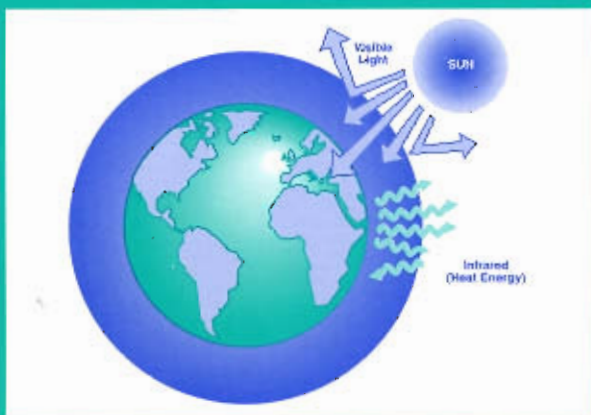


### Exempt from VOC Classification/Smog Free

The EPA exempted FORMACEL Z•2 from classification as a volatile organic compound (VOC) because it doesn't break down in the lower atmosphere, which can cause smog.



### Very Low Global Warming Potential (GWP)



### Global Leadership in Alternatives Development

- broadest range of alternatives to CFCs (chlorofluorocarbons)
- three commercial facilities in production

**FORMACEL® Z•2**  
 FOAM EXPANSION AGENT

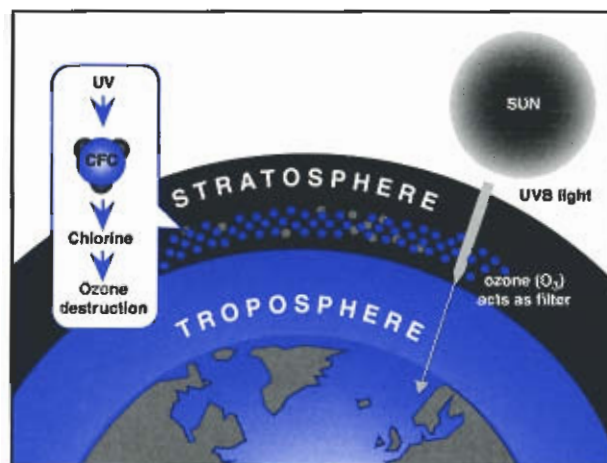

## Zero ozone depletion potential

Most people today have heard about the Earth's ozone layer and its depletion caused by chlorine-containing compounds. The ozone layer is located in the Earth's stratosphere, 15 to 25 kilometers above the Earth, and acts as a giant filter, screening out some of the sun's potentially harmful ultraviolet rays. Scientists believe that too much exposure to ultraviolet radiation could result in an increased incidence of certain forms of skin cancer, and could damage the human immune system, certain food crops and aquatic life.

It is hypothesized that chlorine-containing compounds released into the atmosphere rise to the stratosphere, where they break down releasing chlorine. In a complex series of chemical reactions, the chlorine attacks the ozone molecules, thereby contributing to the "thinning" of the ozone layer.

In the mid-1980s, scientific evidence was sufficiently compelling to build a consensus for international controls on chlorine-containing compounds including chlorofluorocarbons (CFCs). An international agreement regulating the production and use of CFCs took effect in mid-1989. The agreement, called the Montreal Protocol, calls for a stepwise reduction of CFCs in developed countries until they are completely phased out of use around the turn of the century or perhaps sooner.

Polystyrene food packaging manufacturers were among the first to switch to non-CFC compounds. By the time the Montreal Protocol was enacted, the transition by manufacturers to alternative compounds such as hydrochlorofluorocarbons (HCFCs) was nearly complete. These HCFC compounds contain many of the same properties as CFCs but have only 5 percent of the ozone depletion potential (ODP) of CFCs.



Because HCFCs contain chlorine, they still have the potential (albeit a small potential) to deliver chlorine into the stratosphere. For this reason, they have been banned from use in noninsulating foams effective January 1, 1994.\*

Du Pont FORMACEL® Z•2 expansion agent is classified as a hydrofluorocarbon (HFC), and HFCs do not contain chlorine. Since FORMACEL Z•2 contains no chlorine, its ozone depletion potential is zero and it will not deplete the Earth's ozone layer. FORMACEL Z•2 is available today as a replacement for HCFC foam expansion agents as well as for hydrocarbon (butane, pentane) expansion agents which have adverse environmental impacts of their own.

For more information on Du Pont FORMACEL Z•2, call 1-800-441-9420.

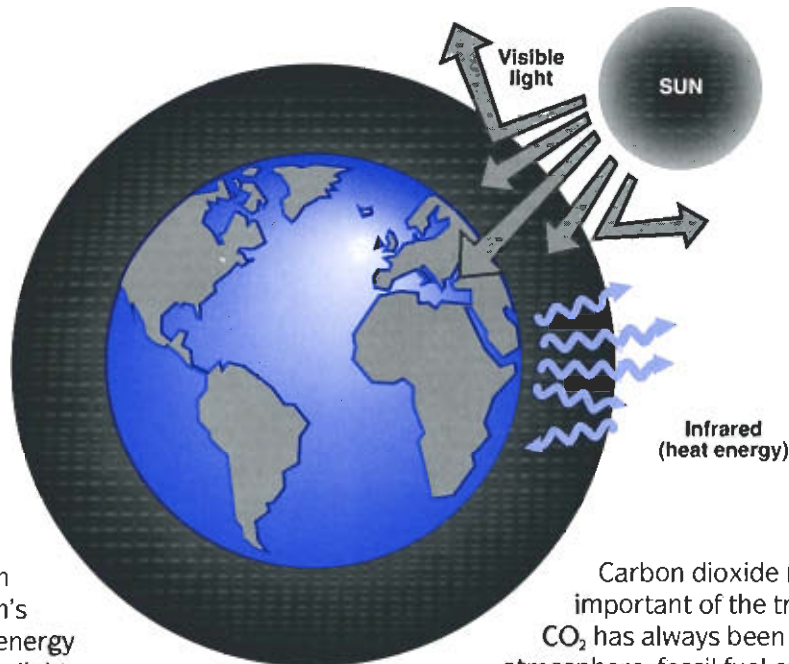
\*According to the Clean Air Amendment passed by the U.S. Congress in 1992.

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## Global warming and the greenhouse effect



The greenhouse effect is an important part of the Earth's natural system. The sun's energy reaches the Earth as visible light.

After passing through the atmosphere, part of the light is absorbed by the Earth's surface and is converted into heat energy. The Earth, now warmed by the sun, radiates heat energy back into the atmosphere towards outer space. Because of their molecular structures, certain gases in the atmosphere absorb some of this outgoing heat energy. This process slows the rate of heat loss, making the Earth warmer than if this radiant heat had simply passed unobstructed through the atmosphere into space. This "trapping" of energy by the atmosphere is referred to as the Earth's greenhouse effect.

By increasing the temperature of the Earth, the greenhouse effect allows life to exist on the planet. Scientists have calculated that the Earth's surface would be about 60° F cooler than it is today if there were no greenhouse effect. Human activities are increasing the amount of some of the atmospheric trace gases which are responsible for trapping outgoing radiant heat energy. Increases could lead to a gradual warming of the earth, commonly referred to as global warming. As a result, questions have been raised about the degree to which our activities are altering the heat balance of the planet.

Carbon dioxide (CO<sub>2</sub>) is the most important of the trace gases. While CO<sub>2</sub> has always been a part of the atmosphere, fossil fuel consumption over the last 200 years has increased the amount of CO<sub>2</sub> in the atmosphere by an estimated 25 percent. Modern society has also added chlorofluorocarbons (CFCs) to the mix of atmospheric trace gases. Gram for gram, CFCs are more powerful greenhouse gases than CO<sub>2</sub>, but are present in much smaller concentrations. The Montreal Protocol, which limits and eventually phases out the use of CFCs, will arrest the warming contribution of these compounds. Even so, the growing intensity of energy use by our societies, along with expanding world population, continues to fuel concern over the concentrations of the major greenhouse gases, CO<sub>2</sub> and methane.

The search for alternative foam expansion agents to replace CFCs and hydrochlorofluorocarbons (HCFCs) has led to the development of Du Pont FORMACEL® Z•2 (HFC-152A). The lifetime of Z•2 in the atmosphere is sufficiently short and its ability to absorb outgoing heat energy is negligible. Concentrations of Z•2 released into the atmosphere are not expected to contribute to the phenomenon of global warming.

For more information on FORMACEL Z•2, call 1-800-441-9420.



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FOAM EXPANSION AGENT

## VOCs, tropospheric reactivity and smog formation (ozone)



The presence of ozone (O<sub>3</sub>) in the Earth's stratosphere is desirable. The ozone layer acts as a giant filter screening out certain harmful ultraviolet radiation that would otherwise reach the Earth's surface. However, ozone in the troposphere (at or near ground level) is highly undesirable. It is one of the major irritants found in smog. One source of tropospheric ozone is caused by the photochemical reaction of volatile organic compounds (VOCs) with hydroxyl (OH) radicals. The Environmental Protection Agency (EPA) defines VOCs as: "any organic compound, other than those specifically considered exempt from regulation, as VOCs

because of their very low reactivity." The most common foam expansion agents classified and regulated as VOCs include: n-pentane, pentane, butane, n-butane, and their isomers.

Du Pont FORMACEL® Z•2 expansion agent has been granted an exemption from regulation as a VOC by the EPA. FORMACEL Z•2 is stable enough to resist photochemical reactivity in the troposphere. Its rate of reaction with hydroxyl radicals is so slow that it does not result in significant tropospheric ozone formation.

For more information on FORMACEL Z•2, call 1-800-441-9420.

