GREEN CHEMISTRY-
REAL APPLICATIONS - (b)

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Environmental chemistry
and Green chemistry

Blowing agent-

A blowing agent is a substance which is capable of producing a cellular structure via a foaming process in a variety of materials that undergo hardening or phase transition, such as polymers, plastics and metals. They are typically applied when the blown material is in a liquid state. The cellular structure in a matrix reduces density, increasing thermal and acoustic insulation, while increasing relative stiffness of the original polymer.

Blowing agents (also known as Pneumatogens) or related mechanisms to create holes in a matrix producing cellular materials, have been classified as follows:

(1) Physical blowing agents include cfcs (however, these are ozone depletants, banned by Montreal Protocol of 1987) HCFCs (replaced (CFCs) but are still ozone depletants, therefore being phased out) hydrocarbons (e.g Pentane, Isopentane, cyclopentane) and liquid CO_2. The bubble/foam-making process is irreversible and endotherm i.e it needs heat (e.g from a melt process or the chemical exotherm due to cross-linking) ; to volatilize a liquid blowing.

agent. However, on cooling the blowing agent will condense, i.e. a reversible process.

(2) Chemical blowing agent- include isocyanate and water for Polyurethane, Azodicarbonamide for Vinyl, hydrazine and other nitrogen based materials for thermoplastic and elastic ie foams and $NaHCO_3$ for thermoplastic foams,

(3) Mixed Physical and chemical Blowing agents are used to Produce flexible Polyurethan foams with very low densities. For instance to avoid this Polyurethane systems isocyanate and water (which react to form carbondioxide) are used in combination with liquid CO_2 (which boils to give gaseous form).

(4) Mechanically made foams and froths, involves methods of introducing bubbles into liquid Polymerisable matrices. Method include whisking in air or other gases or low boiling volatile liquids in low viscosity, lattices or the injection of a gas into an extruder barrel or a die, or into injection molding barrels or nozzles and

and allowing the shear / mix action of the screw to disperse the gas uniformaly to form very fine bubbles.

(5) Soluble fillers, e.g Solid Sodium chloride crystals mixed into a liquid urethane system, which is then shaped into a solid Polymer Part, the NaCl is later washed out by immersing the Solid molded Part in water.

(6) Hollow Spheres and Porous Particle (e.g glass shells/Spheres, epoxide shells, PVDC shells, fly ash, vermiculite, other reticulated materials) are mixed and dispersed in the liquid reactants, which are then shaffed into a Solid Polymer Part containg a net-work of voids.

Natural blowing agents such as Pentane or CO_2 can be used in all types. manufacturers for many years to produce high-quality products. Since 2000, about half of the foam is blowing with Pentane, the other half mainly with CO_2 combined with HFC-134a (Anthony 2003)

100 Percent carbon dioxide as a blowing agent for the Polystyrene foam sheet Packing market:-

Dow developed a process for manufacturing Polystyrene foam sheets that uses CO_2 as a blowing agent, eliminating 3.5 million pounds per year of traditional blowing agents. Traditional blowing agents deplete the Ozone layer or contribute to ground-level Smog. In addition, Dow will obtain CO_2 only from existing commercial and natural sources that generate it as a byproduct, so this process will not contribute to global CO_2 levels.

In recent years the cfc blowing agents used to manufacture Polystyrene foam sheet have been associated with environmental concerns such as Ozone depletion, global warming, and ground-level Smog. Due to these environmental concerns, The DOW Chemical Company has developed a novel process for the use of 100 Percent CO_2. Polystyrene foam sheet is a useful packing material offering a high stiffness-to-weight ratio, good thermal insulation value, moisture resistance, and recyclability. This combination of desirable properties has resulted in the growth of the Polystyrene foam sheet in the United States to over 700 million pounds in 1995. Current applications for Polystyrene foam include thermoformed meat, poultry, and produce trays, fast food containers, egg cartons, and serviceware.

The use of 100 Percent CO_2 offers optimal environmental Performance because CO_2 does not deplete the ozone layer, does not contribute to ground-level Smog, and will not contribute to global Warming because CO_2 will be used from existing by-Product Commercial and natural Sources, such as ammonia plants or natural gas wells, will ensure that no net increase in global CO_2 results from the use of this technology, CO_2 is also nonflammable, providing increased worker Safety. CO_2 is cost effective and readily available in food grade quality. CO_2 also is used in such common applications as Soft drink Carbonation and food chilling and freezing.

The DOW 100 Percent CO_2 Technology eliminates the use of 3.5 million pounds per year of hard CFC-12 and Soft HCFC-22. This technology has been scaled from Pilot-like to full-scale Commercial facilities. DOW has made the technology available a Commercial license covering both Patent and know-how technology. The U.S Patent-Patent and know-how technology. The U.S Patent-Office granted DOW two Patents for this technology (5,250,577 and 5,266,605).

The green chemistry challenge winning technology-ies annually

(i) Eliminate 826 million Pounds of hazardous chemicals and Solvent (ii) Save over 21 billion gallons of water (iii) Eliminate 7.8 billion Pounds of carbon dioxide releases to air. EPA' efforts to speed the adoption of this revolutionary and diverse discipline have

led to significant environmental benefits, innovation and a strengthened economy. Green chemistry is also known as sustainable chemistry.