

Aerosol systems

As stated, the propellant can either be a liquefied gas (that is, a gas that exists as a liquid under pressure) or a compressed gas that boils well below room temperature. Depending on the type of propellant used, an aerosol spray system can be configured 1 of 2 ways:

- **Compressed gas system**- in this system (the simpler of the 2), the liquid product is poured into the container, which is then sealed. The gas propellant (in this case, a soluble or non soluble compressed gas, see below) is then pumped into the container through the valve system under high pressure, pushing down on the liquid product with significant force.

In general, a long plastic tube runs from the bottom of the container up to a valve system at the top (see image above). When the container's valve is opened (by pressing on the nozzle), the high-pressure compressed gas drives the liquid product up the plastic tube and out through the nozzle. The nozzle serves to atomize the flowing liquid- that is, it breaks it up into tiny drops to form a fine spray.

- **Liquefied gas system**- in this more popular system, the propellant is a liquefied gas. Similar to the system above, the liquid product is poured into the container, which is then sealed. The propellant is then pumped into the container under high pressure via the valve system. When the propellant is kept under high enough pressure, it does not have any room to expand into a gas and remains a liquid.

When the container's valve is opened (by pressing on the nozzle), the pressure on the liquid propellant is instantly reduced. With less pressure, it can begin to boil. As a result, particles break free, forming a gas layer at the top of the can. This pressurized gas layer pushes the liquid product, and some of the liquid propellant, up the tube to the nozzle.

When the liquid flows through the nozzle, the propellant rapidly expands into a gas. In some aerosol containers, this action can help atomize the product, turning it into an extremely fine spray. In other designs, the evaporating propellant forms bubbles in the product, creating a foam.

Types of propellant

Chlorofluorocarbons (CFCs) were once used as non-flammable liquid propellants. Since the discovery of CFCs' destructive effect on the earth's ozone layer, they have been phased out by the Montreal Protocol of 1989. They are, however, permitted in inhalation aerosols, as used in the treatment of asthma.

The most common CFC replacements are:

- **Liquefied Petroleum Gas** (hydrofluorocarbons such as propane, n- butane, and isobutene)- these products are quite flammable and must be used with extreme care.
- **Soluble compressed gases** (e.g. nitrous oxide and carbon dioxide)- typically used in foam applications in the food industry (for example, to dispense whipped cream, see below); both of these gases are inert, odorless, non-flammable, stable, and bacteriostatic (that is, they inhibit the growth of bacteria).
- **Non soluble compressed gases** (e.g. air, nitrogen, argon)- generally used in edible oil applications in the food industry (for example, to dispense cooking oil sprays); these gases are odorless, non-flammable, stable, and "environmentally friendly".

The table below summarizes the main characteristics of the main soluble and non soluble compressed gases used as propellants:

Air	N ₂	Argon	CO ₂	N ₂ O
odorless	odorless	odorless	odorless	odorless
neutral	neutral	neutral	acid	neutral
oxidant	inert	inert	inert	inert
non flammable	non flammable	non flammable	non flammable	non flammable
stable	stable	stable	stable	stable
"green"	"green"	"green"	+/-	Green house effect
non soluble	non soluble	non soluble	soluble	soluble
			bacteriostatic	bacteriostatic

Examples in the food industry

Aside from cooking oil, in the food industry, one of the best-known aerosol applications is whipped cream. When the container's valve is opened, the propellant (typically N₂O) expels the cream from the nozzle. Using this technique, the user can produce 4 times the original volume of cream; in effect, the propellant also "inflates" the product.

A recent innovation of note is instant inflated dough. Using aerosol technology, the user is able to make Blinis, or pancakes, by spraying liquid batter directly onto a frying pan, where it self-inflates instantly.