

STRATOSPHERIC OZONE DEPLETION IN THE FASHION INDUSTRY

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The stratospheric ozone depletion has been caused by the human activity through the use of chlorofluorocarbons and other atmospheric contaminant substances and chemicals —as Halons and nitrogen oxides (NOX) among others— which are detrimental for the ozone layer.

The ozone layer controls the temperature in the stratosphere and protects the life on earth from incoming solar ultraviolet light. Exposure to ultraviolet radiation is linked to popular problems such as worsening of the immune system, skin cancer and cataracts in humans and damage in plants and marine ecosystems in the nature.

The ozone layer is located in the stratosphere around 15-30 kilometres above the Earth's surface and is formed by ozone molecules. The ozone is a highly reactive gas formed by comprised groups of three oxygen atoms which concentration varies depending on the temperature and the season of the year, making it different year by year at all locations. This situation used to be different, as the first investigations (1957) showed that the layer was stable until 1970-1980 when new researches revealed signs of trouble.

In 1974, Mario Molina and Sherwood Rowland, chemists at the University of California, Irvine, published an article in the sciences journal *Nature*¹ in which they explained threats to the ozone layer by the chlorofluorocarbons (CFC). At the moment of the publication, CFCs were commonly used in aerosol sprays and as coolants in many refrigerators. The consequences of these gases are immense as at the moment they reach the stratosphere, the sun's UV rays break CFCs down into substances that include chlorine, making the famous "hole" in the ozone layer.

Molina and Rowland —who received the Chemistry Nobel Prize in 1995 for their investigations on this topic— revealed that the ozone layer has a finite capacity of absorbing chlorine, making the depletion of the ozone layer faster than it can be replaced —one molecule of chlorine can destroy more than 100,000 ozone molecules².

Years later, in 1985, Molina and Rowland's work got proved when a team of English scientists found the hole in the ozone layer located over Antarctica, which was later linked to CFCs. The "hole" is actually an area of the stratosphere with extremely low concentrations of ozone that reoccurs every year at the beginning of the Southern Hemisphere's spring (August to October) as the sunlight is more present than in winter and the radiation is higher.

¹ World's leading multidisciplinary science journal.

² According to the U.S. Environmental Protection Agency.

FASHION INDUSTRY

The ozone depletion is not only caused by the fashion industry but there are some processes, components and parts of the supply chain that reduces the level of O₃ in the atmosphere. This reduction is caused by different chemicals known as Halogens —fluorine, chlorine, bromine, iodine and astatine and its derivatives. These substances can be found in:

- **Bromine** is used as intermediaries in the manufacture of dyes.
- **Methyl bromide** is a fumigant that has been used commercially since the 1930s.
- **Chlorine** is used as a bleaching agent in the leather, textile and paper industries, as an oxidant, as a bactericide and as an antiseptic. It is also used to clean leather and to whiten cellulose, oils and beeswax.
- **Bromine** and **chlorine** are used to whiten and treat wool so that it does not shrink. Also as a flame retardant in the plastics industry —plastic-based fibres.
- **Phosgene gas (COCl₂)** —one of the chlorine oxides— is necessary in large quantities for numerous industrial syntheses, such as the manufacture of dyes, insecticides and fumigants.
- **Cyanogen bromide** is used as a pesticide.
- **Carbon** is used as decolorizing agent.
- **Carbon tetrachloride** is currently used as a solvent in the extraction of oils, fats and waxes; in the rubber and leather industry and as a chemical for paintings and some inks.
- **Carbon disulfide** is an important industrial solvent.
- **Nitrogen oxides** caused by the means of transport when distributing materials or products.

Even though after the celebration of the Montreal Protocol of the United Nations in 1987 — considered to be one of the most successful environmental agreements of all time— the use of CFCs was drastically reduced not only because of their ozone depleting qualities but also for being powerful greenhouse gases. After recognising its benefits for the Earth's climate, in September 2007 all the members agreed in accelerating the phase out of CFCs and completely erase them by 2020.

The Protocol's Scientific Assessment Panel had proved that the ozone layer would recover by the middle of the current century. In order to avoid the depletion of the ozone layer there are some alternatives for the fashion industry:

- **Production of the raw materials:** Avoid the usage of fertilisers, fumigants, bactericides and chemicals as are harmful also for the life on land. As an alternative to these components, the organic farming and organic agriculture is the best option.
- **Production of the materials and garments:** Be conscious of the inks and dyeing methods used for the garments, choose alternative dyeing methods and water-based inks. Choose materials which natural colour without dyeing is similar to the desired final colour. Avoid bleaching and the usage of non-natural waxes and oils.
- **Distribution:** Produce and buy locally to shorten the footprint and the emission of substances as nitrogen oxides mentioned before.

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