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Effect of Stratospheric Conditions on Diffusion of Chlorofluorocarbons in Air †

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Abstract: The main transport route of chlorofluorocarbons (CFCs) from lower to higher atmospheric layers is gaseous diffusion. The effect of Antarctic stratospheric pressure and temperature conditions on the gas diffusion of CFC-12 was initially studied. The values of its diffusion coefficients in the air were calculated using the Fuller-Schettler-Giddings equation [1, 2] and atmospheric data by NASA [3]; they increase from 200 to 7500 times concerning the values on the Earth's surface. Respective collision cross-sectional parameters, ε_{AB}/k and σ_{AB}, were calculated using a methodology developed by our group, utilizing experimental diffusion coefficients, determined by Taylor dispersion Gas Chromatography, related to the diffusion of ten chlorofluorocarbons in air, in a wide temperature range from 273.2 to 453.2 K, at the seasonal stratospheric pressure and temperature conditions [4-6]. Then, the collision cross-section values, σ_{AB}, were used to calculate the values of the mean free path, λ. Results for the CFC-12-air binary system revealed that in general, λ values increase with increasing altitude, in a slightly different way depending on the season and whether the temperatures are minimum or average. The percentage change in λ values indicates that they increase approximately 50 to 200 times in the range of stratospheric clouds.

Keywords: CFCs; CFC-12; air; diffusion coefficient; collision diameter; stratosphere; altitude; temperature; pressure.

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Conflicts of Interest

The authors declare no conflict of interest.

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