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Evaluation of the impact of future HFC replacements on air pollution and global warming

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The phase-out of the consumption and production of (stratospheric) ozone-depleting chlorofluorocarbons (CFCs) was completed in 2010, while the scheduled phase-out of most hydrochlorofluorocarbons (HCFCs) is expected by 2030. During the gradual disappearance of HCFCsover the coming decades, hydrofluorocarbons (HFCs) were proposed as long-term replacements in several industrial applications. Despite HFCs are non-depleting ozone substances,most of themare potent greenhouse gases (GHGs) that affect the radiative forcing of climate change. Their strong IR absorption in the atmospheric window and their long atmospheric lifetime result in high global warming potentials (GWPs). To decrease climate forcing,the emissions of high-GWP HFCs have to be reduced and replaced by substances that have low impact on climate. Among these, hydrofluoroolefins (HFOs) and perfluorinated compounds (PFCs) are expected to be good alternatives to HFCs. For instance, $CF_3(CF2)_2CH=CH_2$ (HFO 1447fz) is currently being considered as a substitute of HCFC-141b as expansion agent in polyurethane foams. Or $CF_3CH=CH_2$ (HFO-1243zf) could replace CF_3CH_2F (HFC-134a) in air-conditioning units.To assess the environmental impact of the potential widespread use of these potential substitutes, an evaluation of the atmospheric chemistry is needed. Degradation of pollutants in the troposphere is usually initiated by OH radicals(the main diurnal oxidant) and, under certain circumstances,by Cl atoms. In our group, the rate coefficients for the OH and Cl reactions with some HFOs and PFCs have been determined under tropospheric conditions of temperature and pressure. Identification of secondary gaseous products and organic aerosols was alsocarried out simulating a clean and polluted atmosphere.The IR spectra of these species were recorded in order to calculate their radiative efficiency. All these resultsallow the estimation of the atmospheric lifetime, GWP and the photochemical ozone creation potential of the HFC substitute. Therefore,we can predict the impact of future emissions on air quality and global warming.

Biography

Elena Jimenez Martinez has a vastexperience in investigating the gas-phase chemistry of primary and secondary pollutants and their atmospheric implications. Her research is focused on the kinetics of different removal processes in the troposphere (reaction with tropospheric oxidants and UV photolysis) together with the formation of secondary pollutants (gaseous and particulate matter). The aim of her research is then the evaluation of the impact of potential CFC replacements, such as fluorinated and perfluorinatedcompounds on air pollution and their contribution on the global warming. A great list of fluorinated compounds has been investigatedup to now. The daytime chemistryof these CFC substitutesis mostly dominated by gas-phase reaction with OH radicals. The obtained OH-rate coefficients for can be included in the chemistry modules of atmospheric models. Dr. Jiménez is also involved in the gas-phase chemistry of interstellar molecules at temperatures down to 110 K (ERC project NANOCOSMOS).

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