

Fire without smoke

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Could combustion without flames be used to build industrial gas turbines for power generation that are much more efficient than current models and produce almost no polluting emissions? Researchers in the Middle East provide a possible answer in the current issue of the Inderscience publication, *International Journal of the Environment and Pollution*.

Mohamed Sassi of The Petroleum Institute in Abu Dabi (United Arab Emirates) and colleagues, Mohamed Hamdi and Hamaïd Bentîcha, at the National School of Engineers of Monastir (Tunisia), explain that flameless combustion, or more precisely flameless oxidation (FLOX), has become a focus of industrial research. It has, they say, the potential to avoid one of the major noxious pollutants from gas turbines, NO_x , or nitrogen oxides.

In flameless combustion, the oxidation of fuel occurs with a very limited oxygen supply at very high temperature. Spontaneous ignition occurs and progresses with no visible or audible signs of the flames usually associated with burning. The chemical reaction zone is quite diffuse, explains Sassi, and this leads to almost uniform heat release and a smooth temperature profile. All these factors could result in a much more efficient process as well as reducing emissions.

The team has now modeled flameless combustion in a so-called adiabatic combustor, of the kind typically used in gas turbine engines in which methane is burned to drive a turbine for electricity production. They carried out detailed calculations of reaction rates and have analyzed the chemical reactions taking place. "The main objective of our study was to

provide a fundamental understanding of the physical and chemical processes that occur during combustion in high-temperature air or exhaust gases with a low content of oxygen," explains Sassi.

The results of the team's simulations clearly show that even at high operating temperatures and pressures, NO_x emissions are reduced to very low levels, suggesting that flameless combustion could become an effective way of ameliorating pollution in power generation.

Source: Inderscience Publishers

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