Secondary organic aerosol formation in the ozonolysis of biogenic volatile organic compounds performed in a laminar flow reactor

T. Braure$^{1,2}$, V. Riffault$^{1,2}$, A. Tomas$^{1,2}$, M. Duncianu$^{1,2}$, Y. Bedjanian$^{3}$ and P. Coddeville$^{1,2}$

$^1$Université Lille Nord de France, F-59000, Lille, France
$^2$Mines Douai, CE, F-59508 Douai, France
$^3$Institut de Combustion Aéothermique Réactivité et Environnement, F-45071, Orléans, France

Keywords: limonene, α-pinene, nucleation, aerosol yield.

Presenting author email: tristan.braure@mines-douai.fr

The oxidation of Biogenic Volatile Organic Compounds (BVOC) emitted by vegetation, such as monoterpenes (C$_{10}$H$_{16}$) or sesquiterpenes (C$_{15}$H$_{24}$), is an important source of Secondary Organic Aerosol (SOA). Because of their large global emissions and high reactivity with the major atmospheric oxidants (Atkinson and Arey, 2003) – and particularly with ozone (O$_3$) – they are believed to be the dominant contributors to global SOA formation (Kanakidou et al., 2005).

α-Pinene and limonene are two of the three most important BVOC emitted in the atmosphere (Griffin et al., 1999), with conifers as major sources (Geron et al., 2000, Pokorska et al., 2012). These two BVOC (especially limonene) are also emitted in indoor air by air fresheners and cleaning products such as kitchen cleaners and dishwashing detergents (Huang et al., 2011). It has been highlighted in previous studies that their reactions with ozone could produce SOA (Chen et al., 2011, Waring et al., 2011, Bernard et al., 2012) either in atmospheric or indoor environments, and could then lead to significant climate (Myhre et al., 2001) and health (Gaschen et al., 2010) effects.

In the present work, the ozonolysis reactions of limonene and α-pinene have been investigated at room temperature and atmospheric pressure using a laminar flow reactor newly developed in our laboratory (Figure 1, Duncianu et al., 2012), which allows the monitoring of the first steps of ozonolysis reactions (typically ~30 seconds to 5 minutes) providing complementary data to more widely performed smog chamber experiments.

The rate coefficients have been measured under pseudo first-order conditions in excess of the BVOC. The decay of ozone has been monitored with an O$_3$ analyser while BVOC concentrations have been determined using online sampling onto adsorbent cartridges followed by thermodesorption and subsequent analysis in a GC/FID-MS system. Specific experiments have been performed to identify and quantify both gas-phase and particulate products using a TD/GC/FID-MS system, a SMPS and a HR-ToF-AMS, respectively.

Results will be further discussed and compared to literature data.

Figure 1. Schematic of the experimental setup and instrumentation (MFC: mass flow controller) (adapted from Duncianu et al., 2012).

Our laboratory participates in the Research Institute of Industrial Environment (IRENI) which is financed by the Communauté Urbaine de Dunkerque, the Nord-Pas de Calais Regional Council, the French Ministry of Education and Research, and European funds (FEDER). The CaPPA project (Chemical and Physical Properties of the Atmosphere) is funded by the French National Research Agency (ANR) through the PIA (Programme d’Investissements d’Avenir) under contract ANR-10-LABX-005. M. Duncianu and T. Braure are grateful for PhD scholarships from the Nord-Pas de Calais Regional Council and Armines.

Geron, C. et al. (2000) *Atm. Env.* 34, 1761-1781.
Huang, Y. et al. (2011) *Atm. Env.* 45, 6191-6196.