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Characterization of Glycol Ether Emissions from a Water-based Paint: Chamber Tests and Field Experiments

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Summary: In order to document glycol ether emissions from a water-based paint, emission test chamber and field experiments were conducted. VOC identified in paint emissions were mainly propylene glycol, 1-(2-butoxy-1-methylethoxy)-2-propanol and 2-(2-butoxyethoxy)-ethanol. VOC emissions were high during and just after painting (e.g. propylene glycol concentrations > 10 mg.T⁻¹). Indoor concentrations were modelled using a simple sink model to document the influence of the air exchange rate: the higher the AER, the lower the indoor concentrations. High ventilation of the painted room or a delay before re-entering into a freshly painted room appear as simple but efficient recommendations for limiting exposure to water-based paints emissions.

Keywords: water-based paint, emission test chamber, field experiment, modeling

1 Introduction

The purpose of this paper is to present the characterization of glycol ether emissions from a water-based paint as documented from test chamber methods and from a realistic field experiment and to study the influence of ventilation conditions on indoor concentrations.

2 Methods

Two layers of the selected paint were applied with a 24 hours interval on pre painted gypsum boards installed on the walls of a 32 m³ test room of the CSTB experimental house (MARIA). Ventilation conditions were controlled by mechanical extraction during the experiment (air exchange rate = 1.0 h⁻¹). The field experiment was simulated in an emission test chamber (COMPAQ). VOC were sampled on Tenax TA and analysed by TD/GC/MS/FID.

3 Results

Main identified VOC emitted by the tested paint were propylene glycol, a mix of isomers of 1-(2-butoxy-1-methylethoxy)-2-propanol (DPGBE) and 2-(2-butoxyethoxy)-ethanol (DEGBE). Indoor concentrations were high during and ~ 8 hours after application of the paint: e.g. propylene glycol concentrations > 10 mg.m⁻³ (TWA WEEL, AIHA). Then, indoor concentrations sharply decreased during the first days after paint application. We observed a good agreement between results obtained under realistic conditions from the field experiment and from the emission test chamber, especially after 10 days (Figure 1). Indoor concentrations were modelled using a simple sink model [1]. For the three main identified VOC, we obtained a good agreement between modelled and measured

concentrations (see the example of DPGBE on Figure 2). Three different air exchange rates (AER) were simulated using this model (5.0, 1.0 and 0.2 h⁻¹): the higher the AER, the lower the indoor concentrations.

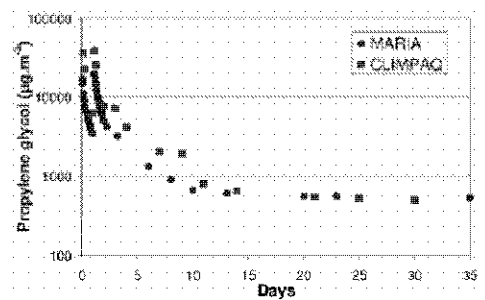


Fig. 1: Propylene glycol concentrations ($\mu\text{g.m}^{-3}$) measured in the experimental house (MARIA) and in the emission test chamber (CLIMPAQ).

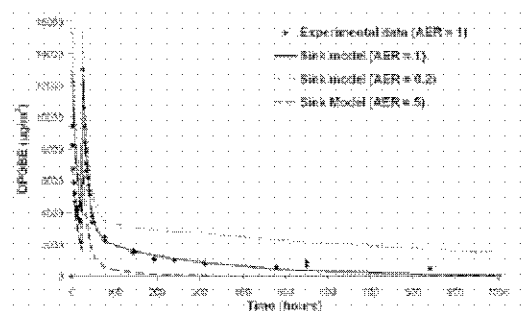


Fig. 2: Measured and modeled indoor DPGBE concentrations ($\mu\text{g.m}^{-3}$) depending on the AER (h^{-1}).

References

- [1] J.E. Dunn and B.A. Tichenor. Compensating for sink effects in emission test chambers by mathematical modeling. *Atmospheric Environment* 22 (1988) 885-894.