Constant emitting reference material for emissions test procedures

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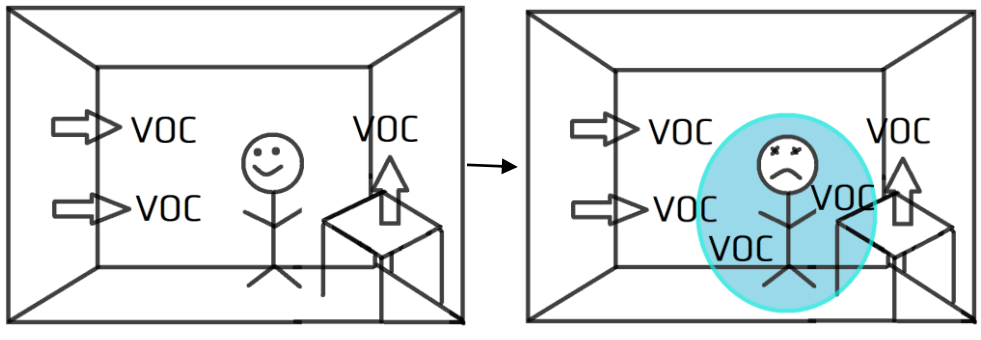
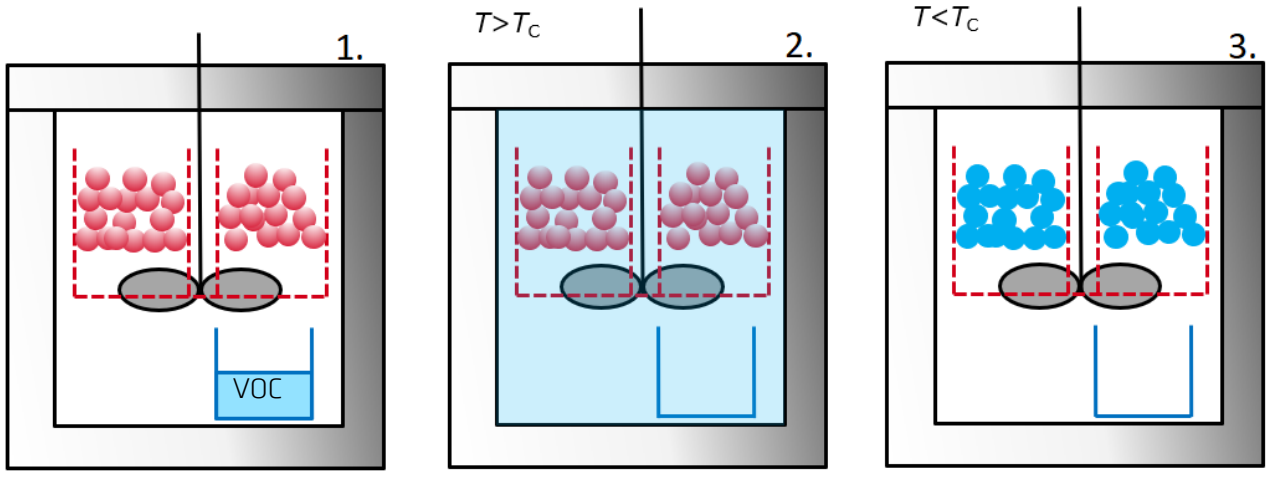
Volatile organic compounds´(VOCs) emitted by furniture and building materials can cause health issues. For an improvement of indoor air quality low emitting materials should be used. Quality assurance and –control (QA/QC) measures require an emission reference material (ERM) with a predictable emission rate of VOCs. The idea is to use porous materials as ERM, which store the VOCs inside their pores and emit them constantly.



Impregnation process



Preparation | Impregnation (supercritical) | Termination (subcritical)

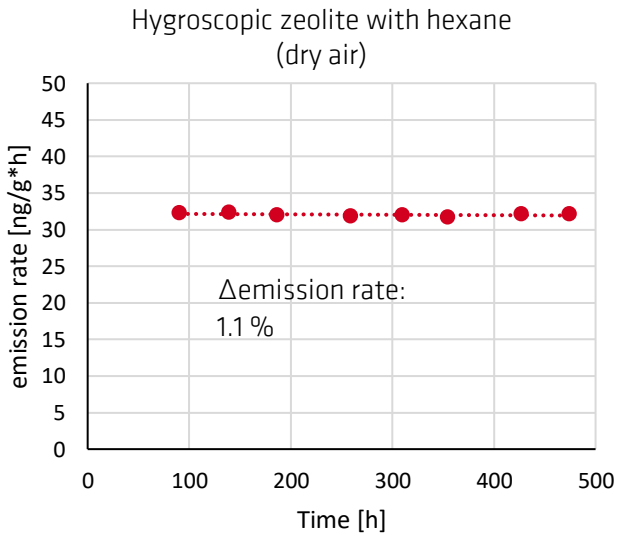
The porous material and the VOC are added into the autoclave. It is then closed and the CO_2 is introduced into the tightened autoclave, which is then heated up until the supercritical state (73.75 bar, 31 °C) of CO_2 is reached. In this state, the CO_2 functions as a solvent for the impregnation.
The basket, containing the porous material, is flushed by the CO_2/VOC mixture with help of a stirrer. Afterwards, the pressure and/or temperature is slowly lowered to ambient conditions.

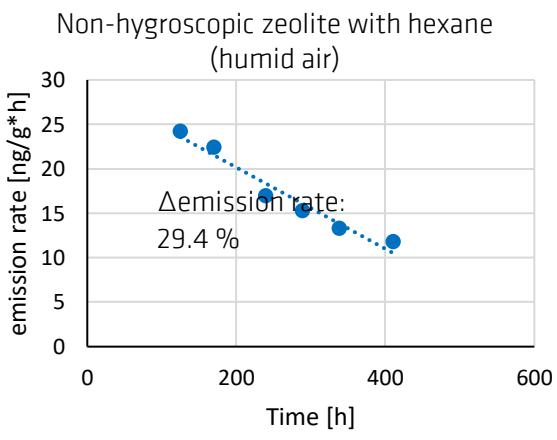
Measurements

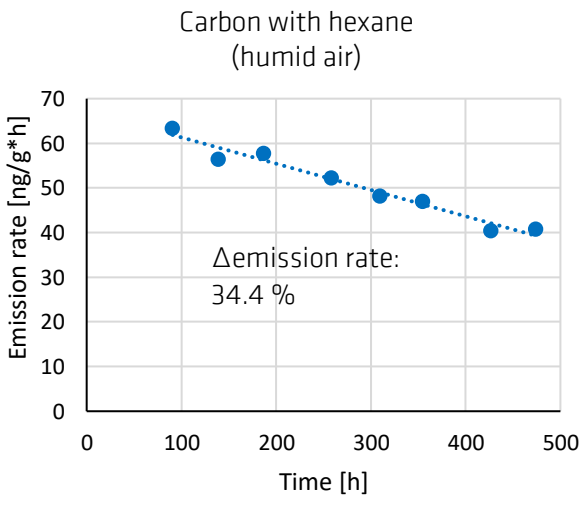
The impregnated samples are placed into emission test chambers (here: µ-chambers, 22 and 270 L chambers. Samples were taken every 2–3 days using Tenax® TA tubes and analyzed using a gas chromatograph (GC) coupled with a mass spectrometer.

Results

With variations of pressure, temperature and impregnation time the impregnation process was optimized.
Different impregnated zeolites were tested in dry air. It was found, that such a material can achieve the projects' aim of less than 10 % change in emission rate over 14 days (1.1 % change). However, according to EN 16516, emission tests have to be carried out at a relative humidity of 50 %. In humid air, no emission was found for "regular" zeolites. In contrast, non-hygroscopic zeolites (Si/Al ratio > 150) exhibit a change in emission rate of 20–35 % over 14 days. Another non-hygroscopic and porous material type is (activated) carbon. The change in emission rate of tested carbons is worse (29.4 %) but after ~200 h the emission rate becomes more constant (21.4 %).







Conclusion

The emission behavior of impregnated zeolites already exhibits the desired stability of ≤ 10 % change in emission rate over 14 days, at least for dry testing conditions. It was further proven, that non-hygroscopic zeolites and activated carbons can be used for humid testing conditions, though the change in emission rate is yet relative high (20–35 % change). We will continue to study the influence of material properties on the stability of emission, and hopefully find even better candidates. In addition, a variety of VOCs will be tested in the future.

References: EN (2020). Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air (EN 16516:2020). Beuth, Berlin.

Sicherheit in Technik und Chemie

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This project 20NRM04 MetrIAQ has received funding from the EMPIR programme co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.

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The EMPIR initiative is co-funded by the European Union's Horizon 2020 research and innovation programme and the EMPIR Participating States