Title

Reference values for building material emissions and indoor air quality in residential buildings

Abstract

Indoor air concentrations and emissions from structures and interior materials were investigated in eight residential buildings during the time of construction and the first year of occupancy. Volatile organic compounds (VOCs), formaldehyde and ammonia concentrations and emissions as well as temperature, humidity, and ventilation were measured.

The total VOC (TVOC) concentration was generally above the S3-class limit of 600 µg/m^3 (FiSIAQ 2001) in the newly finished buildings but the concentration usually decreased below the S3-level and in some apartments below the S1-level of 200 µg/m^3 in six months. The concentrations of the major VOCs decreased most strongly during the first six months of occupancy, reaching mean concentration levels of 5-15 µg/m^3. Variables affecting the concentrations of indoor air gaseous pollutants in the buildings were the ventilation system, the floor covering material, the ceiling surface product, the wall surface product, the season, the relative humidity and temperature of the indoor air, and occupancy. The relative humidity (RH) affected ammonia and formaldehyde concentrations most strongly. Higher concentrations were measured when the RH was above 50% during the follow-up. The formaldehyde concentration did not significantly exceed the S2-class level of 50 µg/m^3 during the first year in any of the apartments. In some newly finished buildings and during the follow-up, the indoor air concentrations of ammonia were above the S3-level of 40 µg/m^3. The emission measurements performed from the complete floor construction showed that the emission was affected by all of its components, i.e., the structure, leveling agent, adhesive, and floor covering material. Significantly higher emissions were often measured on-site from the complete floor structure than from the single materials measured in the laboratory. The impact of adhesives on VOC emissions from the complete PVC- coated structures was clearly seen as higher emissions from those with a more permeable types of PVCs. The contribution of the average on-site measured emissions to indoor air concentration was ~550 µg/m^3 (~57% of the measured concentration) for TVOC and ~45/ 40 µg/m^3 (~100% of the measured concentration) for ammonia and formaldehyde in the newly finished building. The TVOC contribution from surfaces decreased to ~200 µg/m^3 in six months whereas the contribution of ammonia and formaldehyde remained about the same. The ceiling structure contributed by most to the concentration levels whereas the contribution from walls was lower than expected on the basis of large surface area.

The study confirmed that the Finnish material classification system provides a basis to achieve good IAQ when comparing to the target values for pollutant concentrations given by the classification (FiSIAQ 2001) in real buildings; however, suggestions for its further development are given. Based on the indoor air and emission results, reference values, i.e. normal and abnormal values, were defined for the six- and twelve month-old buildings.

ISBN

978-951-38-7075-1 (soft back ed.)

978-951-38-7076-8 (URL: http://www.vtt.fi/publications/index.jsp)

Series title and ISSN Project number

VTT Publications

1235-0621 (soft back ed.)

1455-0849 (URL: http://www.vtt.fi/publications/index.jsp)

December 2007 English, Finnish abstr. 73 p. + app. 63 p.

Keywords indoor air, material emission, VOCs, ammonia, formaldehyde, new buildings

Publisher

VTT Technical Research Centre of Finland

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