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ALBERTA STUDIES IN OCCUPATIONAL HEALTH

Chemical incompatibility between commercial biocides and rigid evaporative cooling media: a possible source of formaldehyde release into indoor air by Verona M. Goodwin

ABSTRACT

This report outlines the background, rationale, methodology and results of the study undertaken to investigate the hypothesis of a chemical incompatibility between biocides and evaporative cooling media (ECM) in a building with poor air quality. As well, the limitations of the study, suggestions for further research and implications of the findings are discussed. It also provides a general overview of indoor air quality problems, biocidal and evaporative cooling products used in buildings, formaldehyde uses and health effects an relevant legislation and guidelines.

Based on the findings of a multistory office building indoor air quality survey, the University of Alberta Occupational Health Program investigators postulated that the low formaldehyde levels detected in the building's office area was due to a reaction between the biocides, sodium dichloroisocyanurate or algicide DC and the rigid ECM in the building's air handling system.

The purpose of project was to replicate these findings. Thus, the study had several aims:

i) to simulate conditions of ECM use on a small scale in a laboratory setting such that sampling conditions would be optimized for detection of formaldehyde,
ii) to confirm the identity of formaldehyde by several methods,
iii) to quantitate the amount and rate of formaldehyde generation, and
iv) to verify the formaldehyde – chromotropic acid analytical method's performance.

The evaporative cooling process was simulated and the likelihood of detecting formaldehyde was optimized by bubbling air through various concentrations of the organochlorine and alkylamino biocide solutions containing fragments of the evaporative cooling media contained within a stoppered flask. Following detection of formaldehyde with colorimetric detector tubes in the screening tests, consecutive, continuous air samples were collected and quantitated using the chromotropic acid method.

ECM continuously and steadily releases formaldehyde at geometric mean rates of 0.292 μg/min when soaked in an aqueous solution containing 500 ppm free chlorine and 0.371 μg/min when in 5000 ppm free chlorine, compared to 0.040 μg/min in tap water, 0.051 μg/min in distilled water and 0.036–0.079 μg/min in 0.5 ppm – 50 ppm free chlorine. The geometric mean formaldehyde release rates from the ECM combined with an alkylamino biocide at concentrations of 5000 or 500 ppm were 0.012 μg/min and when combined with a mixture of the algicide at 500 ppm and organochlorine biocide at 250 ppm free chlorine the geometric mean formaldehyde release rate was 0.021 μg/min.

In this study, the sampling and analytical method's performance parameters, with the exception of its precision, are in agreement with those previously reported. The sampling flow rate was found to be independent of the airborne formaldehyde concentration and the collection efficiency of the midget tapered impinger and coarse fritted bubbler were found to be similarly efficient, collecting 98.3 and

97.7%, respectively, of the total formaldehyde mass in the first impinger. The chromotropic acid method's within-run precision was 0.03—0.19 within the range of 20—200 μg.

The results support the chemical incompatibility hypothesis that formealdehyde is released as a consequence of excessive application of organochlorine biocide, sodium dichloroisocyanurate, to the rigid evaporative cooling media (CELdek, Munsters Corp). As such, the combination of these materials is a potential hazard under specific circumstances, and will be of interest and concern for office workers, building maintenance personnel, and occupational health and safety personnel.