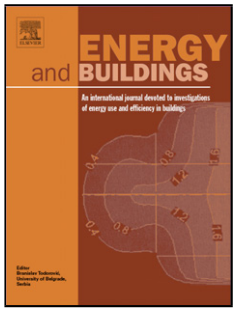

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PII: S0378-7788(17)30474-7
DOI: http://dx.doi.org/doi:10.1016/j.enbuild.2017.02.021
Reference: ENB 7382

To appear in: *ENB*

Received date: 1-10-2016
Revised date: 31-12-2016
Accepted date: 10-2-2017

Please cite this article as: T. Aoyama, T. Sonoda, Y. Nakanishi, J. Tanabe, H. Takebayashi, Study on aging of solar reflectance of the self-cleaning high reflectance coating, *Energy and Buildings* (2017), http://dx.doi.org/10.1016/j.enbuild.2017.02.021

4th International Conference on Countermeasures to Urban Heat Island, 30-31 May and 1 June 2016,
National University of Singapore, Singapore

Study on aging of solar reflectance of the self-cleaning high reflectance coating

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ABSTRACT

The self-cleaning system consisting of waterborne two-component acrylic silicon polymers and alkyl silicate is used as a highly effective self-cleaning coating. This system is useful in the formation of a self-cleaning topcoat that effectively maintains the high solar reflectance of a cool roof after coating. This capability was confirmed by an outdoor exposure test that compared self-cleaning and non-self-cleaning coatings. The energy savings of the self-cleaning coating for cooling were estimated via a cooling load calculation.

Key Words: acrylic silicon polymer, alkyl silicate, self-cleaning, aging, solar reflectance, topcoat, cool roof

1. INTRODUCTION

Cool-roof coatings have received considerable attention worldwide as a solution for the “heat island” effect in urban areas. The effects of cool-roof coatings, including their reduction of air-conditioning loads, have been studied. High reflective cool-roofs have been widely assessed as an effective solution to save cooling energy[1)-2)] and offset CO_2 emissions[3)]. Cool-roof coatings remain cooler than the absorptive roofs due to their high solar reflectivity and high infrared emittance. Cool-roof coatings can also reduce the ambient temperature of the building by reducing the emitted sensible heat. A large number of experimental studies have been performed on existing residential[4)-5)] and non-residential buildings[6)].

To maintain maximum cooling energy saving throughout the service lifetime, high albedo roof coatings should retain their original properties for the entire duration[7)]. However, the solar reflectance of cool-roof coatings has been found to decrease shortly after installation[8)]. Roofing materials are exposed to environmental conditions and consequently degrade over time. Some research pointed out that this decrease in solar reflectance is due to roof soiling (chemical-physical modifications) and biological growth on the coating[9)]. Other studies suggest that black carbon particles, known as soot particles, are the primary cause of reflectance loss. Further investigations proposed that the service life of the reflective surfaces may be extended if the surface temperature is lowered during the sunshine hours to reduce the diurnal thermal expansion and contraction[10)]. The change in reflectance caused by sun exposure and washing, as well as the simulation of annual cooling and heating load are studied[11)].

Various evaluation methods for cool-roof coatings have been studied. Studies have investigated the decrease in the solar reflectance due to soiling of the coating and the relationship between outdoor-exposure and accelerated-aging tests in particular[12)-15)]. In Japan, the main component of soil is carbon. It has been reported that, after 16 weeks of exposure of the white test piece, the reflectance in the visible light region is reduced by about 5 to 10%[16)].