Study on Halogen-Free Fireproof Paper

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ABSTRACT

Flame resistant papers are widely applied to honeycomb board, poster board, decorative paper, furniture, lampshades, electronic appliances, sunscreen for automobiles, air filters, wallpaper, ceilings, powder keg etc. There is a dearth of suitable and available flame retardant agents, however. Furthermore, suitable flame retardants for flame resistant papers are often regarded by manufacturers as proprietary knowledge, which causes the existence of very few publicly accessible commercial and academic research information on the subject. There were even fewer reports on additives for making such and their effects on base paper. Therefore, this study aims to establish a research protocol for making halogen-free flame resistant papers and to provide such formulations to both academic and producers as a reference. In the study, a few minerals, including Al(OH)3, CaCO3, kaolin clay, sericite, nano sericite, nano silica, Mg(OH)2, and organic phosphorus-nitrogen compound were applied to base sheets through surface coating and internal addition methods and their flame resistant performances were assayed experimentally. Another part of the study entailed adding Al(OH)3, CaCO3, kaolin clay, sericite, and Mg(OH)2 internally to the base sheets, then using the organic phosphorus- nitrogen compound as surface coating in order to find the optimal proportions of internal addition and coating amounts. Accelerated ageing and water vapor absorption tests of the optimally formulated flame resistant sheets were then conducted to evaluate the changes in the mechanical properties of the sheets. Finally, evaluation on the economic efficiency of the optimal flame resistant paper formulation was made. Surface coating treatment results indicate that Al(OH)3. CaCO3, kaolin clay, sericite, or nano silica alone was unable to attain flame resistant efficacy at the upper coating cap of 80 g m-2; only Mg(OH)2 and organic phosphorus-nitrogen compound had such performance as single coating ingredients. Nano-sericite, when mixed with Mg(OH)2, however, produced a synergistic effect to boost flame resistance of the magnesium hydroxide coated paper by about 12.5%. Internal addition treatment of base paper results indicate that all chemicals studies failed to attain flame resistant efficacy at the dosages used in the experiments. The probable reason is that the chemicals generally served as filling agents among fibers which by not covering the fibers fully is unable to enhance their flame resistance. The internal addition plus surface coating treatment results indicate that when CaCO3, kaolin clay, sericite or Mg(OH)2 was added internally at a 10% w/w fraction, and when Al(OH)3 was added at a 30% w/w fraction, in conjunction with a 20 g m-2 coating of organic phosphorus-nitrogen compound, effective flame resistance of the paper were achieved. Based on the study, these were deemed the optimal formulations for making flame resistant papers.

Keywords : flame retardant agents, dual flame resistant treatment, surface coating flame resistant treatment, internal addition flame resistant treatment, flame resistant papers.

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