Thermal insulation coating based on water-based polymer dispersion

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Abstract. The paper presents a study on the development of thin-layer thermal (with a thermal conductivity coefficient ranging from 0.0416 to 0.083 W/(m·K)) insulation coatings based on styrene-acrylic aqueous dispersion with improved adhesion properties and regulated technological characteristics. The simplicity and speed of applying liquid thermal insulation provide significant advantages over standard insulating materials. An advantage is the ability to insulate surfaces of complex configuration.

1. Introduction

Thermal insulation materials find applications in various sectors, including industrial and civil construction, where they are used as coatings for external insulation of buildings and structures to prevent heat loss to the surrounding environment [1–3]. Additionally, they are employed in insulating the pipelines of heating networks, boilers, and other thermal appliances to reduce heat loss and protect personnel from contact burns caused by hot metal surfaces of pipelines and reactors. These materials are also suitable for protecting refrigeration equipment and serving anti-condensation and protective-decorative functions [4, 5]. Apart from the energy saving and the related reduction in CO_2 emissions, insulation also offers additional advantages: in an insulated building or industrial piping system one encounters a more uniform temperature distribution which results in a more agreeable living experience or improved plant operation respectively [6–8].

Modern thin-layer polymer thermal insulation materials can be categorized into roll-type and paint-type [9, 10]. In the Ukrainian and international markets, a variety of modern roll-type thermal insulation materials are used, which are based on foamed polyethylene, polypropylene, polyvinyl chloride, polystyrene, polyurethane foam, and carbamide resins [11]. Thermal insulation based on foamed polyethylene (thermal conductivity coefficient: 0.044-0.051 W/(m·K)) and polypropylene (thermal conductivity coefficient: 0.034 W/(m·K)) exhibits low water absorption and is considered chemically and biologically resistant. It is important to highlight that these materials are flammable, which results in flame propagation along the material's surface. Furthermore, they possess low adhesion, making their installation challenging and diminishing their anti-corrosion properties [12, 13].