# PERFORMANCE OF SOLVENT-BORNE INTUMESCENT COATINGS WITH SINGLE BIOFILLERS (RHA AND POC) AND HYBRID FILLERS

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## Introduction

Fire is one of the sources of hazard in a building. Knowing the characteristics of fire and its spread can help architects, engineers, and other professionals formulate life safety and property protection strategies in building's design. All buildings need to be designed according to the acceptable fire safety limits to reduce and minimise any fire event risks. Therefore, precautionary measures must provide fire safety for the occupants to clear out the building in the building regulations. Fire resistance in a building structure can be described as the capability of a building to endure the results of fire in one or more ways. The primary basis of fire resistance is the insulation, integrity, and stability of the structure. Structural integrity needs to be included in the fire safety design system for any installation during the fire. Fire protection is often needed for all types of wood and plastics to stop ignition and combustion. Steel materials also need fire protection to avoid building collapse in the event of a massive fire. During uncontrolled fire situations, steel is vulnerable not because of the explosive properties but due to the decrease of the steel structure's rigidity when exposed to high fire temperatures, as occurred in the World Trade Centre collapse [1].

All commonly used structural materials will lose some of their mechanical strength when exposed to fire. Steel absorbs a significant

amount of thermal energy during the fire and loses its properties when exposed to a high temperature between 470-500°C [2]. The most elevated and critical steel temperature is 550°C, where the strength of steel will decrease and lead to the building's collapse. Two fire protection methods are usually applied to building structures to protect the occupants and delay the collapse of steel structures in a catastrophic event. The first method is the active fire protection method. This method is a built-in dynamic method that is also used to retard the fires in progress. It is also known as the manual or automatic fire protection systems, including fire alarms, heat and smoke detectors, hose reels, automatic sprinklers, etc. This method's primary function is to warn of an outbreak of fire and the containment and extinguishment of a fire. Passive fire protection (PFP) is one of the structural fire protection methods and is widely used for steel within the building. PFP aims to protect and delay the spread of flame in the event of a fire. PFP is a planning matter and must be considered at the planning stage in the building design. Typical types of passive fire protection are spray-on coating, gypsum boards, and intumescent coatings [3].

Intumescent coatings are the most preferred method to protect a steel substrate against fire. They are created to protect a substrate under critical conditions and maintain the integrity of steel for up to three hours. The word 'intumescent' is defined as charring and swelling when exposed to the flame's heat. Intumescent systems have three main components to form an effective protective char layer: an acid source, a blowing agent, and a carbon source or donator.

The PFP system is still low due to the high cost of commercial intumescent coating available in the Malaysian market. Globally, the application of intumescent coatings in steel fire protection has increased since 2001 compared to other PFP methods [4].

Industrial waste materials are being used in intumescent coatings to solve waste disposal problems, protect the environment, and reduce costs [4]. The industrial waste from Malaysia's agricultural industry, including palm oil and paddy, has been adopted to research sustainable concrete materials [5]. This research focuses on developing a new formulation of intumescent coating using palm oil clinker (POC), a by-product from the oil palm industry, and rice husk ash (RHA) from the rice milling industry. The fire resistance performance of single POC and RHA bio fillers is examined and compared with intumescent coating derived from bio and industrial fillers.