9 The use of biocides in paint preservation
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9.1 Introduction

In order to grow in or on a paint, a microorganism must have available moisture (water) and a nutrient source. Paints typically contain a number of ingredients, some of which are susceptible to degradation by microorganisms. Examples of such degradable components include:

- thickener, especially cellulosic thickeners;
- binder (emulsion);
- minor ingredients, such as coalescing agent and defoamer.

Water-borne paints, if unprotected with a biocide, are prone to microbial spoilage (Bravery, 1988). Such paints require a biocide package for effective protection: an in-can preservative for wet-state protection, and a paint film biocide for protection of the dried film. Solvent-borne paints do not typically require in-can protection, but the dried film usually requires a preservative. Paint film protection and in-can preservation are two separate functions required of paint biocides and will be discussed separately.

9.2 Why use a film biocide in paint?

Paint is used for protection and decoration of surfaces; both these functions may be defeated by biodeterioration. This spoilage occurs only in certain environments, where temperatures and humidity levels are suited to microbial growth. The primary class of microorganisms involved in paint film attack are fungi (mildew organisms). Microbial growth is common in exterior paints (Hueck-van der Plas, 1968), but fungal growth can also occur in interior situations where there is high humidity; typically in domestic dwellings this occurs in bathrooms and kitchens (Barry, 1978). In certain geographical locations, such as South East Asia, algae may present more of a problem than fungal deterioration (Wee, 1982).

The presence of microorganisms on a paint film is undesirable because they cause discoloration and disfigurement. Microorganisms cover the surface of a paint with a fine network of cells, which can increase dirt retention, dulling the paint surface. Many fungi are darkly coloured, and some produce pigmented spores, giving the paint film a ‘dirty’ look.
The presence of microorganisms on the surface of a paint does more than just detract from the appearance of the paint. It can lead to an increase in film porosity, a loss of film integrity, and an ingress of water to the substrate. If that substrate is wood, then not only will the flaking and cracking of the paint be a problem, but the contact of water with the wood becomes a serious problem in itself, and may in turn lead to decay of the wood.

Algal growth only occurs outdoors and on paint that is usually applied over masonry substrate, so cracking, flaking and disfigurement are the main consequences of algal growth (Wee and Lee, 1980).

9.3 Historic developments of paint biocides

Traditionally, this market was composed of heavy metal containing products. Some examples include phenyl mercuric acetate (pma) and tributyl tin (tbt) compounds. These materials offered many advantages, such as:

- a broad spectrum of activity;
- in-can preservative action in addition to film protection.

However, these materials had the disadvantages of:

- high toxicity—the products were environmentally unacceptable;
- short-term effectiveness.

These products have been replaced with a new generation of non-metallic products, which have the following advantages:

- low toxicity, and
- high selectivity of target organism(s).

These newer generation products do have some disadvantages, such as:

- increased cost, and
- they lack the all round performance of the metallic biocides.

In other words, the high selectivity of the newer generation products means high specificity of the biocide. For example, there are now separate and distinct biocide products for the paint market which are primarily fungicides, algicides or wet-state preservative, but no single product will fulfill all of these functions simultaneously.

In terms of future developments there are increasing environmental restrictions on new materials. Extensive toxicological requirements have to be met in the registration of new active ingredients, which makes development very expensive. This indicates that there will be few truly new biocides brought to market in the foreseeable future. One possible route for development will be re-formulation of ‘old’ products, and the blending of existing active ingredients, to produce new formulated products. Formulated products (i.e. products based on a