Micro-emulsion Technologies for the Cost Optimization of Fluorescent Penetrant Inspection Processes

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Introduction

Currently many of the state-of-the-art products for the penetrant inspection of mass produced parts consist of considerable amounts of unfavorable solvents such as mineral oils and glycol ethers, which can be detrimental to health and some of these also contain surfactants providing at least a question over product biodegradability. Although these materials use ingredients of high flash points, they are flammable and contribute to the hazard profile of the process.

Water-based water-washable fluorescent penetrant processes are favored for the testing of automotive engine and transmission parts, because they eliminate some of these safety and environmental drawbacks. Without making any concession to the flaw detection, these processes offer a very favorable environmental profile with no VOC and an easier and cost efficient treatment of the rinse waters compared to hydrocarbon solvent based or even surfactant based water-washable penetrants.

Fig. 1: Turbo charger wheel with sprayed-on Britemor® 921 (W)

Nowadays, a few water-based water-washable products are already available in the market. Usually they consist of water as the indicative fluid and water-miscible solvents in order to dissolve the fluorescent dyes which are not soluble in water alone. In addition to surfactants, they are able to adjust the wetting, viscosity and washability characteristics. Balancing all the ingredients is the challenging task. The exact formulation of the penetrant will define the finesse of the products composition and decides on the products market success, while still competing against classical designed penetrants.
Ecological-sound and process cost efficient penetrant testing with Britemor® 921 (W)

Today, Chemetall is introducing Britemor® 921 (W), a unique, patent-pending technology which is promoting the benefits of water-based penetrants even further. The formulation includes a high proportion of water whereas most available products in the market place are based on a glycol ether / surfactant mix, to the detriment of waste water loads and sometimes even to the user's health. The high proportion of water reduces tremendously the chemical oxygen demand and offers a very favorable ratio between the chemical oxygen demand (COD) and the biological oxygen demand (BOD).

![Graph showing BOD and COD values of different penetrant types](image)

Fig. 2: BOD and COD values of different penetrant types

These features reduce the environmental impact of the rinse water as well as the cost for its treatment, as the process requires less consumables, such as activated carbon. The significantly lower viscosity of Britemor® 921 (W) is an additional benefit of the micro emulsion technology. The reduced drag-out rate decreases the overall penetrant consumption. Thus Britemor® 921(W) can contribute to a process cost efficient penetrant testing.

The micro emulsion technology provides dye-containing domains (“droplets”) of a very small size, encapsulated by readily biodegradable surfactants, surrounded by water, appearing as a visually clear fluid.

![Scheme of a micro emulsion domain (droplet)](image)

Fig. 3: Scheme of a micro emulsion domain (droplet)
The use of ingredients to provide excellent solubility properties for fluorescent dyes allows the incorporation of a higher quantity of these dyes, providing bright flaw indications. In addition, users of the Britemor® 921 (W) reported a significantly reduced background fluorescence, making the flaw more easily visible, even on rougher surfaces. This is due to the increased stability of the penetrant against the dilution by water in the rinsing process, whereas current water-based materials as well as conventional products tend to precipitate fluorescent dye sticking to the test parts surface producing an undesirable luminous background, impeding the ease of flaw detection.

Britermor® 921 (W) was qualified as a level 1 water washable penetrant according to ISO 3452-2. It can be applied by immersion, brush or spray. Self-developing is also possible.
Considering all the advantages given by the micro emulsion technology, such as better flaw indication, exceptional low fluorescent background, new state-of-the-art environmental profile and favorable consumption parameters, Britemor® 921 (W) is the ideal solution for performing a modern and cost efficient penetrant inspection process.