DEVELOPMENT AND APPLICATION OF THE MICROEMULSION COMPOSITE MATERIALS WITH BIOBASED ADDITIVES

Bodachivska L.Yu., *Verba A. Yu.*
V. P. Kukhar Institute of Bioorganic Chemistry and Petrochemistry of the National Academy of Sciences of Ukraine, Kyiv, Ukraine
bodach@ukr.net

Any kind of metal mechanical alterations is accompanied by use of metalworking fluids (MF). These fluids are generally multipurpose materials, which provide removal of metal debris from operation zone, cooling of equipment details, prevention of wear and corrosion during the metalworking. Hence, use of MF increases productivity, accuracy and purity of processing and, in many cases, decreases duration and a number of manufacturing steps. Among the most promising AMF are microemulsions. Microemulsions are superdipersed systems, which contain nanoscale droplets in a bulk phase and, in contrast to macroemulsions, have both thermodynamic and kinetic stability, thus, they are steady in time. This stabilization effect is a consequence of extra-low interfacial tension between water and oil phases that usually is provided by the mixture of surfactants.

For preparation of microemulsion MF we used following components: Nonylphenol ethoxylated with 10 moles of ethylene oxide NP-10 (Chemproduct, Ukraine), as a surfactant; Triethanolamine TEA (Sigma-Aldrich Chemie GmbH, Germany), as a co-surfactant, corrosion inhibitor and inhibitor of bacteriological processes; Benzoic, salicylic, boric acids (Chemlaborreactiv, Ukraine), as a co-surfactant and corrosion inhibitor; Sulfur-rich fatty acid ethyl esters with 10, or 30 wt.% of S (10S-FAEE and 30S-FAEE respectively), as an extreme pressure additive and friction modifier. S-FAEE and WG we obtained from unrefined rapeseed oil; Waste glycerol (WG) from biodiesel manufacturing, as a co-surfactant, stabilizer and cooling agent. Microemulsion MF was achieved by sequential preparation and mixing of solutions, or dispersions of above described components. Firstly, we dissolved 1.0 g of NP-10 in 6.5 g of demineralized water, followed by addition of 1.4 g of TEA, 0.7 g of 10S-FAEE and 0.4 g of WG. This dispersion was mixed at the room temperature for 2 min, until formation of reddish emulsion. At the second step, four solutions were prepared by dissolving of 0.04 g of benzoic, salicylic, or boric acids in 90 g of distilled water. Finally, we received MF via agitating of initial emulsion and acid solutions during 2–3 min. Besides, we designed microemulsions with addition of 30S-FAEE by the similar technique. However, in this case we decreased mass fraction of NP-10 and sulfurized fatty esters in two times.

Table 1. Composition and characterization of MF

No	Composition, wt.%					Characterization				
	NP-10	TEA	WG	Tribological additive – content	Acid – content	Viscosity, $mm^2 \cdot s^{-1}$	pH	Steel corrosion	*Pc*, N	*Pw*, N
1	1.0	1.4	0.4	10S-FAEE – 0.7	Benzoic – 0.04	1.18	9.2	Non	1235	1303
2	1.0	1.4	0.4	10S-FAEE – 0.7	Salicylic – 0.04	1.22	9.3	Non	1166	1235
3	1.0	1.4	0.4	10S-FAEE – 0.7	Boric – 0.04	1.47	9.3	Non	1039	1235
4	0.5	1.4	0.4	30S-FAEE–0.35	Salicylic – 0.03	–	9.3	Non	1180	1744

In summary, we want briefly outline industrial importance of designed composition. Ethoxylated nonylphenol and TEA are widely used inexpensive components for achieving of stable non-corrosiveness aqueous dispersed systems for metalworking operations. Application of available in Ukrainian market benzoic, salicylic, or boric acid, instead of deficient eodecanoic acid, not only economically advantageous, but also enables to achieve stable microemulsion MF with improved properties.