

Antimicrobial activity of model microplastics loaded with a toxic polycation

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Microspheres (MSs) from carboxylated (butadiene-co- α -methylstyrene) copolymer (7:3) (JSC Voronezhsintezkauchuk, Sibur branch, Russia) were used as model microplastics. The unreacted monomers and additives were removed from MSs by dialysis for three days against bi-distilled water using SERVAPOR dialysis tubing, MWCO 12000–14000, RC, 16 mm in diameter (SERVA Electrophoresis GmbH, Germany). The water in the outer cell was changed three times per day. The concentration of dialyzed MSs was determined gravimetrically. The quantity of carboxylic groups (COOH) of MSs was measured by potentiometric (with pH-meter pH-420, Aquilon, Russia) and conductometric (with conductivity meter CDM 83, Radiometer, Denmark) reverse titration of a MS water suspension. Before titration HCl was added to the MS suspension until a pH 3.4 was achieved, in this case carboxylic groups turn into a protonated form.

The quantity of carboxylic groups, expressed in moles of COOH per g of MSs, was equal to $(8.1 \pm 0.1) \times 10^{-5}$ mol/g. The required volume of MS suspension was then diluted with the 10^{-2} M phosphate buffer solution (pH 7) to prepare MS suspension of the required concentration; the latter was expressed in moles of carboxylic groups per liter [COOH]. The concentration of PDADMAC is expressed in moles of amino groups per liter $[N^+]$.

The formation of PDADMAC–MS complexes was performed by mixing a PDADMAC solution in a 10^{-2} M phosphate aqueous buffer (pH 7) with a required amount of a MS suspension in the same buffer so that the molar ratio $Z = [N^+]/[COOH]$ was in the range from 0 to 1.6.

Dynamic light scattering measurements at a fixed scattering angle (90°) in a thermostatic cell (25°C) with a Brookhaven Zeta Plus instrument (Brookhaven, USA) were used for characterizing size (hydrodynamic diameter) of MSs and their complexes with cationic polymer. Electrophoretic mobility (EPM) of MSs and their complexes was performed in a thermostatic cell (25°C) by laser microelectrophoresis by using Brookhaven Zeta Plus instrument (Brookhaven, USA). Hydrodynamic diameter and EPM values were calculated with software provided by the manufacturer.