THE ROLE OF SULFATE-REDUCING BACTERIA IN THE BIODESTRUCTION OF POLYMER AND RUBBER TECHNICAL MATERIALS

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The wastes of synthetic polymers have a stable chemical structure, resulting in a slow decomposition under natural conditions. The development of environmentally sound biological methods for the disposal of waste is an actual issue. The aim of the study was to investigate the impact of sulfate-reducing bacteria (SRB) on polymeric materials under anaerobic cultivation conditions. Objects of study were *Desulfovibrio* sp. 10, *D. desulfuricans* DSM642, *D. vulgaris* DSM644. Materials were rubber, polypropylene (PPE) and ethylenevinyl acetate (EVA). Bacteria were cultivated in a liquid medium Postgate "B" without lactate with the sterilized samples of polymers in microaerophilic conditions under 28^{o}C. Exposure time was 14, 30, and 90 days. A sterile medium without polymers serves as a control. The change in the weight loss of the samples was performed gravimetrically, it was calculated the coefficient of destruction of materials. The production of the hydrogen sulfide was estimated by the method of isodiametric titration, pH of cultural liquid was measured potentiometrically, organic acids - by the method of gas mass-spectrometry. Specific catalase and lipase activity was determined spectrophotometrically and expressed per amount of protein. The coefficients of degradation for PPE during cultivation with *D. desulfuricans* DSM642 and *D. vulgaris* DSM644 were 0.57% and 2.80%, respectively. For EVA, the values of the coefficients of degradation were not significant 0.3 – 0.6% and the rubber did not decompose due to influence of SRB cultures. In the control, the pH of the culture medium at 90 days was 6.7 – 7.0. After the cultivation of PPE with *D. desulfuricans* DSM642 the decreasing pH to 5.59 was observed. The cultivation of rubber with *D. desulfuricans* DSM642 lead to the acidification of cultural liquid up to 5.64. In sample of EVA the pH of the medium was in the range of 5.65-7.94. It had noted that after 90 days of cultivation of SRB with polymers the production of hydrogen sulfide increased in 1.5-7.5 times, depending on the bacterial cultures. The most active production of hydrogen sulfide by all bacterial cultures had observed in the presence of PPE in the medium (345.6 – 42.21 mg/l) and EVA (226.6 – 464.6 mg/l). Also the analysis of the content of short-chain carboxylic acids in the SRB cultural liquid has shown the presence of acetic, butanoic and propanoic acids. During the cultivation with polymers it was increased the amount of acetic acid in 1.6 times (compared to control). In cultural liquid of *D. vulgaris* DSM644 with PEE and EVA its synthesis increased 1.2 – 5.6 and 1.2 – 1.7 times, respectively. Butane acid was absent in the control, but it was detected in amount of 1.98 µg/ml in cultural liquids after cultivation with the rubber. The cultivation bacteria with PPE was showed the appearance of butanoic (1.06-6.26 µg/ml) and propanoic acids (2.43-18.20µg/ml). The determination of enzymatic activity showed changes in the synthesis of catalase compared with the control. In the presence of rubber and PPE for *Desulfovibrio* sp. 10 and *D. desulfuricans* DSM642 (5.58 and 3.89 U/mg^{-1} protein, respectively) the catalase activity increasing had shown. At presence in cultural liquid of EVA the increased of catalase activity was fixed for *D. vulgaris* DSM644 (6.19 U/mg^{-1}protein). The increasing of the lipolytic activity comparatively with control had shown for *D. desulfuricans* DSM642 and *Desulfovibrio* sp. 10 with rubber to 22.59 and 45.61 U/mg^{-1} protein, respectively. As for *D. vulgaris* of DSM644 lipolytic activity had decreased during cultivation with all the polymers. The results indicate the potential of SRB to biodegrade the polymeric materials by providing metabolites in the form of inorganic and organic acids and enzymes.