

A.K. Kenessova^{1*} , G.A. Seilkhanova^{1,2} ,
A.B. Rakhym¹ , Yitzhak Mastai³ 

¹Al-Farabi Kazakh National University, Almaty, Kazakhstan

²Center of Physicochemical Methods of Research and Analysis, Almaty, Kazakhstan

³Bar-Ilan University, Department of Chemistry and the Institute of Nanotechnology, Israel

*e-mail: kenessova.aruzhan@gmail.com

Composite materials based on orange and pomegranate peels for Cu (II) and Zn (II) ions extraction

Abstract. The method of obtaining composite materials based on orange (OP) and pomegranate (PP) peels is described. The fruit peels were modified by polyethylene glycol (PEG). Sorption ability of obtained composite materials towards heavy metal ions (Zn and Cu) was studied. The effect of the mass of composite materials and PEG concentration were studied. The optimal concentration of PEG was determined as 0.1%. The maximum removal degree of heavy metals was at 2 and 2.5 g per 100 ml of solution for orange and pomegranate peels respectively. Three different adsorption models were used to describe the sorption process (Langmuir, Freundlich, and BET). The most applicable for the sorption of Zn (II) and Cu (II) ions by both OP and PP is Freundlich theory. Hence, the sorption of Zn (II) and Cu (II) ions by modified peels of orange and pomegranate occurs at a heterogeneous system where the active centers are unevenly filled.

Key words: composite material, orange peel, pomegranate peel, polyethylene glycol, sorption, heavy metal.

Introduction

Thousand tons of fruits are eaten every day around the world. In order of utilization of their peels they can be used as sorbents of heavy metals (HM) from wastewater. In accordance with the WHO (World Health Organization), drinking of low quality water can cause human ailments accounted about 80% of health problems' total amount [1]. Purification of water from various pollutants is currently a relevant task, which requires the application of new approaches as well as environmentally-friendly and resource-saving technologies. All these approaches should give the opportunity to use the purified water in production processes, thus decreasing the consumption of freshwater [2].

Many methods and technologies have been developed for the treatment of wastewater from different types of pollutants, particularly from HM ions. They are electro dialysis, coagulation, reverse osmosis, sedimentation, ion exchange, filtration, flocculation and precipitation [3–6]. However these conventional methods are quite expensive [7]. Among all of the developed methods for the treatment of

wastewater, containing HM ions, an important place is taken by sorption methods. They allow to provide the most complete removal of toxicions, especially from solutions with low concentrations [8, 9]. Hence, adsorption is one of the promising methods for purification of wastewater and industrial effluents [10].

Such composite materials based on fruit peels and other plant raw materials are low-cost and effective. Low-cost bioadsorbents are based on using household wastes, such as peels of banana, orange, kiwi, pomegranate, tangerine, tomato, potato and pumpkin, also tea wastes and pineapple [11]. Agricultural wastes are also used in bio-sorption [12]. The wastes of crops are one of the sources that are rich of low-cost sorbents. Agricultural wastes show ability to adsorb toxic heavy metal ions, such as mercury, lead, cadmium, nickel, zinc and chromium. According to investigated works [13], sorbents based on agricultural wastes are effective for removal of cadmium ions.

Such household waste as eggshell is also used as bioadsorbent. In the work devoted to removal of copper and lead ions from water eggshell [14], banana