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Javad Saien, Sana Daneshamoz

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Compensating effect of ultrasonic waves on retarding action of nanoparticles in drops liquid–liquid extraction

Javad Saien* **and Sana Daneshamoz**

Department of Applied Chemistry, Bu-Ali Sina University, 65174, Hamedan, Iran

ABSTRACT

The influence of ultrasonic waves on liquid–liquid extraction of circulating drops and in the presence of magnetite nanoparticles was investigated. Experiments were conducted in a column equipped with an ultrasound transducer. The frequency and intensity of received waves, measured by the hydrophone standard method, were 35.40 kHz and 0.37 mW/cm^2, respectively. The recommended chemical system of cumene–isobutyric acid–water was used in which mass transfer resistance lies in the aqueous phase. Nanoparticles, within concentration range of (0.0003 - 0.0030) wt%, were added to the aqueous continuous phase. The presence of nanoparticles and ultrasonic waves provided no sensible change in drop size (within 2.49 - 4.17 mm) and measured terminal velocities were close to Grace model. However, presence of nanoparticles, caused mass transfer to decrease. This undesired effect was significantly diminished by using ultrasonic waves so that mass transfer coefficient increased from (73.0 - 178.2) to (130.2 - 240.2) μm/s, providing a 55.6% average enhancement. It is presumably due to disturbing the accumulated nanoparticles around the drops. The current innovative study highlights the fact that using ultrasonic waves is an interesting way to improve liquid–liquid extraction in the presence and absence of nanoparticles.

***Keywords*:** Ultrasonic waves; Magnetite nanoparticles; Liquid−liquid extraction; Mass transfer coefficient; Circulating drops

1. Introduction

Liquid–liquid extraction, a prevalent separation method, has found many applications in different industries and is performed in two major contactor types of mixer-settler and column. Columns are most conventional where drops are dispersed for high contact area.