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Examination of the concentration dependence of acoustical phenomenon in water based suspensions

INTRODUCTION

There is no cavitation in the ultrasound field until the amplitude of the acoustic pressure exceeds a certain level, the cavitation threshold (Fry 1978). Cavitation threshold is proportional with the frequency of ultrasound, with the hydrostatic pressure in the liquid, and with the viscosity of the sample and it is inversely proportional with the gas content and temperature of the sample (Suslick 1988 cit. Ter Haar 1988). There are two types of cavitation that are stable and transient cavitation (Suslick 1988 cit. Frizzel 1988). Basically two reactions take place when ultrasound and a media interact with each other. One of them is the absorption the other one is the scattering, which changes e.g., the speed of propagation of the sound in the subject media (Fry 1978 cit. Hill et al. 1978). Due to the absorption, the intensity of ultrasound decreases exponentially with distance and the absorption coefficient primarily depends on the speed of propagation of the sound in the subject media, on the wave type, on the material situated in the ultrasound field and on the frequency. The absorption always characterizes a media, a structure or an environment that determines the parameters of propagation (Kurtuff 1991). When absorption coefficients were measured in oxo- and és methemoglobin, it was observed that the absorption is proportional with the concentration of hemoglobin in the concentration range between 0 and 15 [g/100ml] (Carstensen and Schwann 1959). It was clearly established that the profile of the ultrasound propagation speed depends on the concentration profile of the suspension (Wedlock et al. 1993). Effects of the size and concentration of the suspended particles on the propagation speed of ultrasound was examined in water based suspensions. It was established that the speed of sound largely depended on the particle size and concentration (Sayan and Ulrich 2002). In vitro cavitation threshold measurements were carried out in human blood. In the fresh blood that contained every blood component, the amplitude of the acoustic pressure belonging to the cavitation threshold was higher than in diluted blood (Deng et al. 1996). Due to cavitation caused by ultrasound, acoustic streaming was formed in the liquid (Saad and Williams 1985). Acoustic streaming is a movement of the liquid that is caused by intensive ultrasound (Mitome 1998). Mixing of liquid was experienced in the ultrasound field due to acoustic streaming (Watmough et al. 1990). An acoustic reflector placed opposite to the transducer causes a standing wave to be formed. In a standing wave the materials whose density are lower and higher than of the liquid drift to propagation cluster planes (pressure antinodes), and pressure nodes, respectively (Suslick 1988 cit. Ter Haar 1988). The ultrasonic separation is used in analytical biotechnology applications. This procedure is based on the fact that in a standing wave field, where there is no cavitation, the cells are arranged in bands distances of which are smaller than a millimeter and they can be separated from these bands (Coakley 1997). Yeast (*Saccharomyces cerevisiae)* and rubber particles were manipulated in a standing wave ultrasound field at frequencies of 1 and 3 [MHz]. The particles formed bands in pressure nodes whose distance from each other was equal to half of the wavelength. In the direction of the radiation the bands formed column like structures. Stability of the bands, the conditions under which they are broken and the formation of the acoustic streaming were investigated in (Hawkes et al 1998). Stability of the banded columns formed by the effect of the standing wave, and the appearance of the cavitation were examined by detecting the formation of the general cavitation sound (Gould 1992). Effectiveness of the cell separation of *Escherichia coli* bacteria and *Saccharomyces cerevisiae* yeast cells from a yeast suspension was examined at frequencies of 1 and 3 [MHz] (Hawkes et al. 1997). As a result of the standing wave, the bands and the bubbles were separated into different layers. In their experiments, the authors placed an absorber opposite to the transducer for avoiding the formation of the standing wave, but the layer of air located opposite to the transducer resulted in an almost total reflection and as a consequence of this, an almost perfect standing wave was formed (Chrunch and Miller 1983).