**Maximum bubble size in aqueous solutions of methyl isobutyl carbinol and NaCl**

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**Highlights**

* Scarcity of fresh water requires to find new sources.
* Electrolytes affects the behavior of frothers in floatation process.
* New explanation for the bubble size generation.

**1. Introduction**

Due to water scarcity mining copper industries in the north of Chile as in many other countries are using new sources of water like groundwater, recirculating water and seawater. These sources of water have salt electrolytes which have unknown effects on reagents as frothers and collectors in the floatation process, where the valuable mineral is separated from the gangue. In the floatation process, frothers avoid bubble coalescence and provide foam stability. It is known that salt electrolytes like NaCl modify properties of the air-liquid interface of aqueous solution with frothers like methyl isobutyl carbinol, one of the most frequently used frothers in floatation [1]. Bubble size is reduced as frother and salt concentration increases [2]. According to a conventional explanation this phenomenon can be explained due to the reduction of bubble coalescence [3,4]. Here we present a new way to understand this behavior evaluating the maximum stable bubble size and their relationship with surface tension and wettability.

**2. Methods**

Aqueous solutions were prepared with distilled water and different concentrations of methyl isobutyl carbinol (MIBC) as a frother and NaCl. The maximum stable bubble size was determined in an optical tensiometer Theta from Attention. Bubbles were generated passing small amounts of air in a hooked needle with a blunt needle point submerged in a transparent glass vessel containing the aqueous solution. Bubble volumes and their surface tensions were obtained by fitting the edges of the bubble to the Young-Laplace equation.

**3. Results and discussion**

Figure 1a shows the maximum stable bubble size for different concentrations of MIBC, for pure water and a solution of NaCl 2M, for an instant measurement and for a measurement realized after two hours of exposure of the solution to the needle pore. Bubble size decreases with increasing MIBC concentration and with the presence of salt. Figure 1a also shows that measurements for the condition of two hours of exposure have a significant reduction of the maximum stable bubble size.

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| (a) | (b) |

**Figure 1.** (a) Maximum stable bubble volume and (b) surface tension at different MIBC concentration for pure water and NaCl 2M. NaCl 2M (2h) means the solution was in contact with the needle for 2 hours.

These results reveals that the generation of bubbles is influenced by surface tension of the solution and the time the solution is in contact with the pore substrate or the needle, which in turn is a manifestation of change in the wettability of the liquid over the substrate. A long exposure of the liquid over the needle pore increases its wettability. A detailed view of the analyzed images reveals that in the case of the instant measurement the base of the bubble fits with the outer area of the needle pore, and that in the measurements with two hours of exposure the base of the bubble has a reduced area. Figure 1b shows the surface tension for the same solutions revealing that the results of NaCl 2M are not affected by the bubble size, as expected.

**4. Conclusions**

The salt electrolyte NaCl has a significant impact on the decreasing of the maximum stable bubble size. These results reveals that the effect of the MIBC and NaCl in the decreasing of the bubble size is not only related to the reduction of the coalescence of bubbles, it is also related to the generation of the bubble; where surface tension, wettability of the solution over the porous and the size of the porous determine the size of the bubbles. In particular, the effect of the frother and the electrolytes over the wettability of the aqueous solutions over the different solids involved in a flotation cell can lead to an unexpected performance of the process.

**References**

1. Castro, S., Miranda, C., Toledo, P., & Laskowski, J. S. (2013). *International Journal of Mineral Processing*, *124*, 8-14.
2. Wang, L. (2015). *International Journal of Mineral Processing*, *134*, 41-49.
3. Bournival, G., e Souza, L. D. O., Ata, S., & Wanless, E. J. (2015). *Chemical Engineering Science*, *131*, 1-11.
4. Samanta, S., & Ghosh, P. (2011). *Chemical engineering science*, *66*(20), 4824-4837.