Effect of Ionic strength on the Degree of Coiling of Carboxymethyl Cellulose Depressant and its Effect on Depressant Adsorption onto Talc

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Talc is a common gangue mineral in South African PGM containing ores, which are beneficiated by flotation. Talc has a high floatability and depressants such as CMCs are added to the flotation pulp in order to prevent it from reporting to the concentrate and minimise its froth stabilising characteristics. Many studies have been dedicated to the investigation of the adsorption of carboxymethyl cellulose (CMC) depressants onto the surface of talc. It has been found that the adsorption of CMC is strongly dependent on the ionic strength of the medium as well as the type of ions present (see Figure 1a). A possible explanation for this is that divalent $\text{Ca}^{2+}$ ions adsorb stronger onto the talc surface than the monovalent $\text{K}^+$ ions. Another possible explanation is that calcium and potassium ions have different effects on the degree of coiling of the polymer molecules, thus creating differences in the degree of adsorption.

This work is a preliminary study that investigates the effect of the ionic strength and types of ions present in the medium on the degree of coiling of the long chained CMC molecules. The degree of coiling was inferred by the measurement of the \textit{intrinsic viscosity} of the polymer solutions. Intrinsic viscosity is a measure of the inherent properties of polymers in solution, which is independent of the polymer concentration. Measurements were performed using a Lauda capillary viscometer, in conjunction with a Cannon-Fenske capillary.

Solutions of CMC were prepared for a range of different ionic strengths of the medium for both calcium and potassium ions, with the ion concentrations ranging from $5\times10^{-3}$ to $5\times10^{-6}$ M. The results showed that at ionic strengths below $10^{-2}$ the presence of $\text{K}^+$ ions resulted in a greater degree of coiling than $\text{Ca}^{2+}$ ions, as indicated by the lower intrinsic viscosity (see Figure 1b). However, at high ionic strengths, the curves no longer show a difference between the effect of $\text{Ca}^{2+}$ and $\text{K}^+$ ions.

![Figure 1(a) Adsorption density of CMC onto talc in solution as a function of ionic strength of $\text{Ca}^{2+}$ and $\text{K}^+$ ions.](image)

![Figure 1(b) Intrinsic viscosity of CMC in solution as a function of ionic strength of $\text{Ca}^{2+}$ and $\text{K}^+$ ions.](image)

This preliminary study shows that ion type does play a role in determining the degree of coiling of the polymer molecules and hence the degree of its adsorption onto talc. However this is only true for a limited range of ionic strengths. However, a more detailed study needs to be undertaken in order to gain a better understanding of this effect.