POLYMERIC FLOCCULANTS AND SELECTIVE FLOCCULATION
AN OVERVIEW

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Behavior of fine particles in aqueous suspensions is markedly different as compared to those at sizes treated by conventional methods for economic recovery. Depletion of natural resources and environmental considerations coupled with the challenge presented by fine particle properties has led to increasing activity in the science and technology of fine particles in recent years. In this connection, the use of water-soluble polymers is of primary importance. This overview presents fundamental aspects of colloid-chemical nature in mixed mineral pulps, together with polymer behavior in solutions and at solid/liquid interfaces. Some new research data are presented, and it is noted that a unified colloid-chemical understanding of such systems is basic to the design of custom-made flocculants that may behave in aqueous media as predicted. Recent trends in flocculant applications and research are also presented with examples.

INTRODUCTION

In the past one could write an article entitled: "Take Flotation it Will Separate" listing many examples of application of 'Froth Flotation', covering minerals, cereals, bacteria, and other seemingly unrelated (?) particulate systems. Following the same pattern, one is now tempted to say: "Fines?, Try Flocculation".

'Fines' is a term used in particulate technology to refer to specific size fractions. In coal processing, for example, fines are, the -28 mesh ($\phi < 0.5$mm) size fractions, while in another
field of mineral processing, such as froth flotation, the term may cover $\phi < 74\mu m$ or sometimes smaller than $10\mu m$ only. The term slimes is also used to mean fines not easily treated by the particular separation technique which happens to be in use in a particular beneficication process. They may constitute 10–40% of the total weight of this starting material.

Fine as described above may occur in the following contexts: (a) Voluntarily produced fines; find examples (i) in the recovery of values from complex ores where the liberation of components is essential, (ii) the production of $\text{Al}_2\text{O}_3$ from $\text{bauxite}$ by the Baeyer Process, which produces the so-called red mud, or the production of fine leftover residues after the recovery of metals by hydrometallurgical process; (b) Naturally occurring (or non-voluntary) fines; for which examples would be (i) systems containing clays, which usually occur in nature in the form of fine powders, (ii) municipal and industrial effluents.

In recent times, one speaks more and more of "depleting natural resources" and "environmental concern". Notwithstanding their other relationships, these two subjects are frequently closely related within the context of "interfacial chemistry". In the former case, one seeks physically and economically feasible means of recovering values via voluntary fines production, while in the latter, one observes that many of the problems and their solutions may be traced to the physico-chemical properties of fine-size particles. One type of approach to problem solution makes use of additives to bring about aggregation in suspensions of fines; which forms the subject of this paper.

Water-Soluble Polymers and Their Uses

One of the means of achieving the desired aggregation is the use of water-soluble macromolecules. These "polymeric substances" have been in use for long times, probably centuries, yet, their potential for the purposes of aggregating suspended solids has been gaining momentum more recently. As an example to age-old practice, it is worth mentioning the use of beaten egg whites, a natural polymer, in wineries for obtaining clearer products. The use of such substances is by no means confined to the aggregation of suspended fines as can be seen from Table I. Even this table is only partly complete, since the applications listed are main headings, many of which could be sub-divided.

Water-soluble polymers can be classified according to their sources, their constitutions and/or the ionic properties they exhibit in aqueous media. According to sources, it is customary