# Research on choice of xanthates blend dedicated to processing technology at KGHM Polska Miedz S.A. concentrators

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**Abstract. A** proper choice of reagents quality and quantity has a great influence on the flotation process effectiveness. Attempts to develop a method to create sodium xanthates blends used as a collector for copper sulphides flotation was undertaken at the Division of Concentrators of KGHM Polska Miedz S.A. Laboratory tests involving different blends of sodium xanthates were performed followed by the data analysis of the results. The obtained results proved that it was profitable to prepare a blend consisted of the so called "weak" and "strong" xanthates with a minimum difference in the alkyl chain length of two carbon atoms. The results of research will be helpful for development of specific xanthates blends dedicated to technology applied at KGHM under industrial conditions.

## 1 Introduction

One of the assumptions of effective flotation process is to properly developed strategy in flotation reagents management. It is a giant challenge to technical staff to compose an accurate blend of xanthates and consumption rate at each feeding point. Currently, the implemented practice is based on empiric confirmation of reagent effectiveness on a laboratory scale tests followed by verification of the obtained data under industrial conditions. However, the ore beneficiation process is a dynamic and multistage flotation system with variations specific for a given ore processing plant. Therefore, some of suggested by other investigators reagents were found unsuccessful under specific industrial conditions.

The level of complexity of flotation and a crucial role of flotation reagent in achieving high production indexes such as metal recovery, concentrate grade and production costs were the reason of taking serious attempts by scientists to improve the sulphide ore flotation regime. One of the proposals, based on theoretical assumptions, was to establish a methodology of preparing xanthates blends for flotation.

Majority of research results led to the only known conclusion that a specific type of xanthate was responsible for good flotation results, conducted under specific reagent conditions, including its type, length and structure of hydrocarbon radical. However, this information is helpful for preparing the

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reagents blend, but is not sufficient, and must be supported by considerable experience and intuition. This work describes new possibilities revealed after a thorough analysis of subject.

## 2 Blends of xanthates

Xanthates are the most important sulphide minerals flotation collectors. Since implementation of froth flotation for the ore processing technology, xanthates has been the basic reagents dedicated to sulphide ores. Because they have a very broad range of activity, the choice of a specific xanthate with suitable chain length and type is not easy. In practice, it is assumed that increasing the chain length will result in increasing the surface activity of collector and its consumption rate can be reduced. However, increasing carbon chain length causes decreasing reagent selectivity.

Introducing into a flotation system only one type of xanthate is not sufficient to ensure the optimised chemical conditions of flotation slurry. This is necessary for proper metal content in the concentrate and high recovery, in addition to process economy. There is no solitude collector which is able to activate the surface all sulphide types present in a polymetallic ore. Better process results can be achieved by introducing a blend of few collectors.

Dosing xanthate blends to a flotation process is widely known since fifties of the last century [1]. However, this subject has been investigated only partly since then. The good results of using the collectors blends in a flotation process are recognized and they are confirmed by laboratory experiments as well as on the full industrial scale. The most important benefits include increased recovery of the valuable components, improved process kinetics, increased process selectivity, improved floatability of the extreme grains: fine and coarse, controlled froth production and reduced process costs due to decreasing dose of the main collector, often the most expensive one. The proper performed blend preparation makes room for improvement of ore processing parameters as well as for cost reduction.

The components of collectors blend are mainly based on experience and knowledge of specialists and technology engineers. Usually, the mixtures are tested in the laboratory scale, and then potentially positive results are verified under industrial conditions. In literature some general phenomena are described, which are helpful in preparing the xanthate blends. The rules of selection of flotation reagents blends was established by Glembotskii [1]. According to him, larger differences in the structure of a collectors blend causes more visible synergic. Hence, the basic composition of xanthates blend includes so called “weak” xanthate, e.g. ethyl or isopropyl and “strong” xanthate with either isobutyl or amyl radical.

At Division of Concentrators of KGHM Polska Miedz S.A. the results of laboratory tests of using blends of xanthates with different carbon chains were investigated.

## 3 Methods and test results

The Polkowice concentrator feed was investigated. The laboratory flotation experiments were conducted for various xanthate types: ethyl, isopropyl, isobutyl and isoamyl. The reagents with short alkyl chains (C2-C3) were defined as weak, while others with longer chains (C4-C5) were described as strong.

The results of flotation experiments were analysed using the Fuerstenau upgrade curve and selectivity factor *a*. The ideal upgrading occurs for *a* value equal to 100 and for its increasing values, process selectivity decreases [2]. The obtained upgrading curves are illustrated in Fig. 1 and *a* values for specific xanthate blends are compared in Fig. 2. The obtained results proved that the assumptions were reflected under KGHM industrial conditions. The minimal values of selectivity index (e.g. the highest selectiveness) are obtained for mixtures consisting of only weak or strong xanthates. If the difference in the length of the carbon chain of reagents present in a blend becomes more significant, the flotation performance achieves better effects. The best results were observed for blending C2 and

C5, while the worst were noticed for the C2 and C3 combination, when there was only one carbon atom difference between alkyl chains' length. Similar phenomenon was observed in the blends consisting of two weak or strong xanthates. These blends contain reagents having difference between alkyl chain too small to observe visible positive effect.

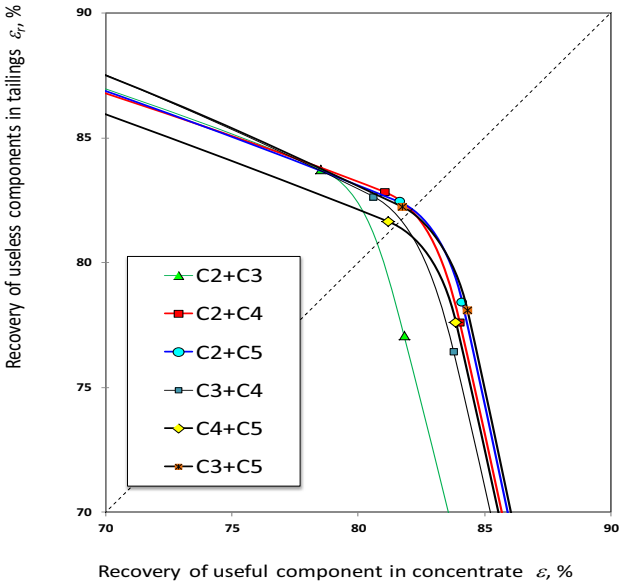


**Figure 1.** A part of the Fuerstenau upgrading curves for different xanthate blends (based on [3]).

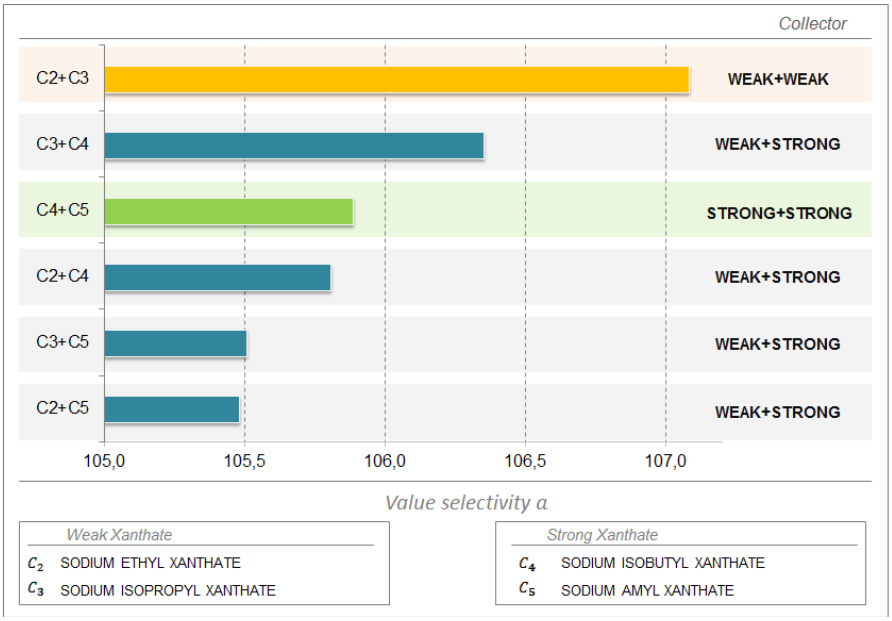


**Figure 2.** Results of implementation of different xanthate blends (based on [3]).

It can be concluded that the difference of only one atom of carbon in the alkyl chain is not sufficient to ensure the optimum flotation conditions. If xanthates are blended, the rule of combining weak and strong xanthates must be respected, providing difference of minimum of two carbon atoms between their alkyl chains.

## 4 Summary

One of the most important factor of flotation performance in copper ore processing is the proper selection of flotation reagents combination. It influences achieving such parameters as recovery, concentrate grade, process costs reduction as well as environment protection. The research and development activity of Division of Concentrators of KGHM Polska Miedz S.A. is focused on selecting new, more efficient than currently used, blend of flotation reagents. It was assumed that preparing new combination of reagents blends should be performed after validation of a confirmed method of preparing xanthate blends. There is a broadly known relation between the type of carbon radical, its structure and length as well as flotation performance. However, the efforts to establish rules of design xanthate blends have not been undertaken yet. Instead, the technologist activity was driven by intuition and experience only. The analysis of previously obtained results of flotation experiments was assumption of achieving the method of combining xanthate blends. It was proven that developing the xanthates blend must respect combining the so-called weak and strong xanthates together. The minimum difference of two atoms of carbon between alkyl chains length should be ensured.

In addition, it should be underlined, that the kind of functional group of reagent are not less important than structure and length of alkyl chain, while selecting reagents blend for sulphide flotation. Since the xanthates blend should be supported by additional reagents, this question will be investigated in future research.

## References

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