Selective Communion is a method to beneficiate primary raw materials, especially ores and industrial minerals, as well as secondary materials. The different comminution behaviors of valuable and waste components is exploited to separate the components subsequently in a simple way, for example by classifying, see Fig 1. The Selective Communion is part of a sorting process, which can separate materials mainly according to their fracture mechanic behavior.

Project Aim: increasing efficiency by reducing energy consumption in beneficiation through Selective Communion as a method for pre-concentration

Method: The compressive strength of fluorite is 38 MPa, of barite is 31 MPa and that of wall rock is 125 MPa. Separate samples with 450 particles each for three different feed fractions and for three different impact velocities are produced for the experiments. The particles are crushed separately by impact. Figure 2 shows the mass distribution of fluorite, barite and the wall rock of one comminution product. After comminution, the fraction 12.5/20 mm is removed from further comminution. This removed fraction contains wall rock and only minor amounts of fluorite. The fluorite is considered as lost. Removing this fraction saves energy in downstream milling. The aim is to decrease the fluorite lost and to increase the energy saving. The specific work index is 8.9 kWh/t for the fluorite and 13.6 kWh/t for the wall rock. The energy to mill the whole feed material F of one sample is termed reference energy \( E_{R,F} \). Whereas the energy saving of the removed fraction 12.5/20 mm is defined as \( E_{S,P} \). The ratio of \( E_{S,P} \) to \( E_{R,F} \) is defined as relative energy saving \( E_S \):

\[
E_S = \frac{E_{S,P}}{E_{R,F}} \cdot 100\%
\]

Results and Conclusion: Impact velocity, feed particle size, energy saving and fluorite recovery stay in a simple relation (Fig. 3), which offers a simple approach for the improvement of multistage comminution for enhanced energy saving. This approach offers the basic for an optimum criterion for the sustainability with respect to the fluorite recovery and the energy saving.

Fig. 2: Particle size distribution of barinite, fluorite and wall rock after selective comminution by impact load (deposit: Marienberg, Erzgebirge; feed fraction: 16/20 mm, cubic particles; impact velocity: 51.5 m/s; impact angle: perpendicular)

Fig. 3: Fluorite recovery \( R_F \) in relation to the relative energy saving \( E_S \) for different feed fractions and impact velocities (Trend function for \( R_F \): \( R_F = 1 - e^{-(E_S-100)}/0.052 \)) with \( a = 0.052 \) as an empiric constant of the comminution system.

This work is financially supported by the European Union (European Social Fund) and the Saxonian Government (Grant No. 100270113) and part of the Project InnoCrush - Dynamic methods of mechanical excavation and comminution for high selective production chains in Critical Raw Materials in Saxony

Dr.-Ing. Max Hesse - M.Hesse@iam.tu-freiberg.de
TU Bergakademie Freiberg | Institut für Aufbereitungsmaschinen | Lampadiusstraße 4 | 09599 Freiberg