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CHANGES IN MAGNETIC SUSCEPTIBILITY OF CHALCOPYRITE INDUCED BY VIBRATION GRINDING

PETER BALÁŽ AND KLÁRA TKÁČOVÁ
Mining Institute of the Slovak Academy of Sciences,
043 53 Košice, Czechoslovakia

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Abstract Changes in magnetic susceptibility of chalcopyrite brought about by vibration grinding in air and methanol were investigated. Significant increase in magnetic susceptibility is ascribed to plastic strain that results in destruction of the long-range order.

The process of size reduction by energy-intensive grinding is accompanied by fine and hyperfine structure changes. These changes can significantly influence physical and chemical properties of minerals and their behaviour in various technological processes. Transformation from antiferromagnetic state to paramagnetic state, under high pressure as well as during energy-intensive grinding was observed [1, 2].

The changes in magnetic susceptibility brought about by vibration grinding of chalcopyrite in different environments were investigated [3, 4]. From data summarized in Table I it can be seen that a 10 to 100-fold increase in specific magnetic susceptibility was observed during grinding. In several cases the measured values exceed by factor of 10 the maximum values found in literature [5, 6].

TABLE I Specific magnetic susceptibility of -5 μm fraction of chalcopyrite vibrationally ground in air and methanol.

Grinding time t_G (min)	Grinding environment	Specific magnetic susceptibility $\chi \cdot 10^{-9}\ m^3kg^{-1}$	-5μm fraction (%)
0 (reference sample)		113.85	0
5		515.27	41
10		1934.03	56
20	Air	4921.84	61
30		6936.88	53
45		7959.65	49
60		11500.60	49
5		798.96	27
10		949.12	35
20	Methanol	1105.80	40
30		981.17	54
45		1029.44	55
60		978.35	65

Significant increase in magnetic susceptibility is caused by critical loosening of the structure of chalcopyrite. Such a loosening caused by crystalline fragmentation and by an increase in lattice strain was achieved during dry grinding and at high energy bulk density in the mill.

The above results lead to the conclusion that the changes in magnetic susceptibility caused by energy-intensive dry grinding may be attributed to a mechanically induced magnetic order-disorder transformation.

Dry grinding in energy-intensive mills may be considered a promising method for deliberate modification of magnetic properties of finely dispersed chalcopyrite. However, the application of this technique as a non-traditional preliminary operation requires further development of theoretical fundamentals, as well as a complex analysis addressing both technological and economic aspects.

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