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MINERALOGICAL COMPOSITION OF TAILINGS REMAINING AFTER FLOTATION OF POLISH Zn-Pb SULPHIDE ORES

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The mineralogical composition of the tailings remaining after the flotation of lead and zinc sulphide ores originating from the two most characteristic areas of the Silesian-Cracovian deposits (Poland) was estimated. The main component of the tailings was dolomite containing non-uniformly distributed isomorphic admixtures of Fe(II) and Mn(II). The tailings from the Boleslaw area differ from those from the Trzebionka area in a relatively high content of iron sulphides and in the frequent occurrence of siderite. Simultaneous thermal identification of siderite and ferroan dolomite in the presence of iron sulphides was performed by using a flowing Ar furnace atmosphere.

Silesian-Cracovian zinc-lead ore deposits (Poland) occur in so called ore bearing dolomites [1], this rock containing an excess of Ca, Some Fe(II) and a small admixture of Mn(II). The tailings remaining after the flotation of lead and zinc sulphides are deposited as a potential raw material. The purpose of the present paper was to estimate the mineralogical composition of the tailings originating from the two most characteristic areas of the above-mentioned deposits, with particular regard to iron(II) carbonate minerals.

Experimental

Average monthly samples of the tailings were taken in the Trzebionka and Boleslaw plants (Table 1) and were analysed by using X-ray diffraction,

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IR spectroscopy, optical and scanning microscopy, micro- and thermal analysis. Thermal analysis was performed with an OD-102 derivatograph (MOM, Budapest).

Table 1 Chemical composition of flotation tailings

Component	Contents, wt %	
	Trzebionka plant	Boleslaw plant
Zn	0.69	1.08
Zn_{ox}	0.22	0.36
Fe	2.64	5.08
Pb	0.33	0.32
Pb_{ox}	0.30	0.26
Cd	0.006	0.0064
Mn	0.20	0.13
CaO	30.84	27.80
MgO	17.85	13.80
S	0.37	4.33
SiO_2	1.54	5.67
Al_2O_3	1.80	0.45

Tailings from Trzebionka plant

In this material, the following components were identified: dolomite, quartz, calcite, clay minerals (orthoclase?), marcasite, pyrite, sphalerite, goethite, cerussite, galena and organic matter. In different microregions of the dolomite occurring in the sample, the presence of Ca + Mg, Ca + Mg + Fe and Ca + Mg + Fe + Mn was found.

The TG, DTG and DTA curves (Fig. 1) reflected the oxidation of FeS_2 (exothermic peak at 420°). The decomposition of dolomite was accompanied by three endothermic peaks (at 730, 760 and 925°); no effect which might be due to siderite (neither in air nor in flowing argon) was recorded. Hence, the conclusion was drawn that the Fe(II) and Mn(II) were present in the sample under examination as non-uniformly distributed isomorphic admixtures in the dolomite [2-10].

The lattice parameters of dolomite measured for the averaged sample were $a_o = 4.813 \pm 0.001$ and $C_o = 16.042 \pm 0.001$ Å. From these data, on the basis of the relationship given by Goldsmith *et al.* [10], the average composition of the dolomite was estimated, the molar ratio Mg:Fe:Mn being taken from Table 1. The obtained result, $Mg_{0.451}Fe_{0.042}Mn_{0.004}Ca_{0.503}CO_3$, corresponds to the formula of ferroan dolomite. The average mineralogical composition estimated for the tailings from the Trzebionka plant is presented in Table 2.

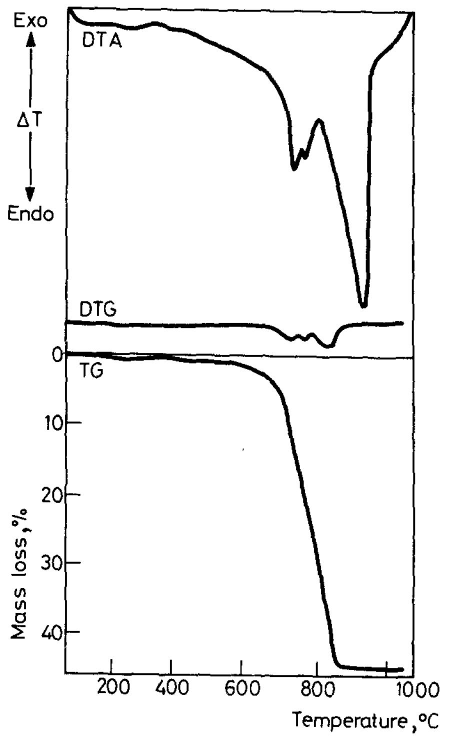

Fig. 1 TG, DTG and DTA curves of tailings from Trzebionka area determined in static air. Heating rate 5 deg·min^{-1}

Tailings from Boleslaw plant

The tailings from this plant contain relatively high amounts of Fe, S and SiO_2 (Table 1). Besides all the components present in the sample from the Trzebionka plant (see above), siderite was identified by X-ray diffraction; the low value of its most intense interference line, d =2.764 Å (compared with d =2.79 Å for pure siderite), probably reflected the presence of an isomorphic admixture of Zn. The characters of the distribution of Ca, Mg, Fe and Mn in the microregions of the dolomite occurring in the two samples were quite similar, although microregions without Fe and Mn seemed to be more frequent in the tailings from the Boleslaw plant.

Table 2 Mineralogical composition of flotation tailings

Component		Contents, wt %	
		Trzebionka plant	Boleslaw plant
Sphalerite (Zn, Cd)S	ZnS	0.71	1.07
	CdS	0.008	0.008
Galena	PbS	0.05	0.07
Marcasite + Pyrite	FeS_2	0.24	7.42
Smithsonite, isom. admix. in siderite and dolomite (?)	$ZnCO_3$	0.43	0.70
Cerussite	$PbCO_3$	0.38	0.33
Dolomite, calcite, siderite	$MgCO_3$	37.3	28.9
	$FeCO_3$	4.99	2.90
	$MnCO_3$	0.42	0.28
	$CaCO_3$	55.0	49.6
Goethite, quartz, clay minerals	Fe_2O_3	0.34	0.43
	SiO_2	1.54	5.67
	Al_2O_3	1.80	0.45
Dolomite of average formula $Mg_{0.451}Fe_{0.042}Mn_{0.004}Ca_{0.503}CO_3$		92.2	
Calcite		5.6	
Siderite		no identified	

The TG, DTG and DTA curves of the sample under examination (Fig. 2) showed a strong exothermic effect with extremum at about 500°, caused by the oxidation of iron sulphides, making it impossible to identify either siderite or ferroan dolomite. Only two dolomite peaks at 810 and 910° were recorded. Thermal analysis in an argon flow (Fig. 3) revealed the presence of both siderite (endothermic peak at 550°) and dolomite containing an isomorphic admixture of iron (endothermic peaks at 620, 800 and 920°). Broadening of the peak at 800° might have been caused by the decomposition of pyrite taking place at 743° [11].

The lattice parameters of dolomite measured for the averaged sample were $a_0 = 4.817 \pm 0.001$ and $C_0 = 16.077 \pm 0.001$ Å. These data were insufficient to estimate the average chemical composition of the dolomite because the Fe(II) distribution between siderite and dolomite remained unknown. Thus, in the mineralogical composition estimated for the sample from the Boleslaw plant (Table 2), the dolomite, calcite and siderite contents have not been distinguished.

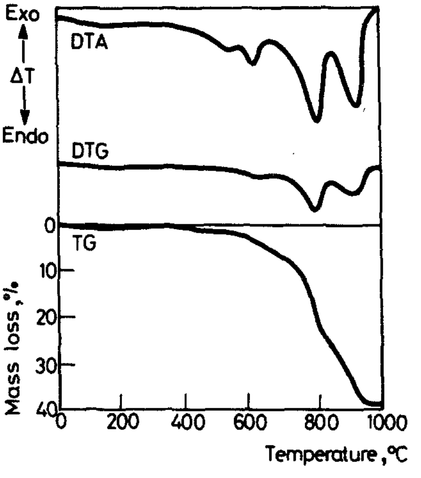

Fig. 2 TG, DTG and DTA curves of tailings from Boleslaw area determined in static air. Heating rate 5 deg·min^{-1}

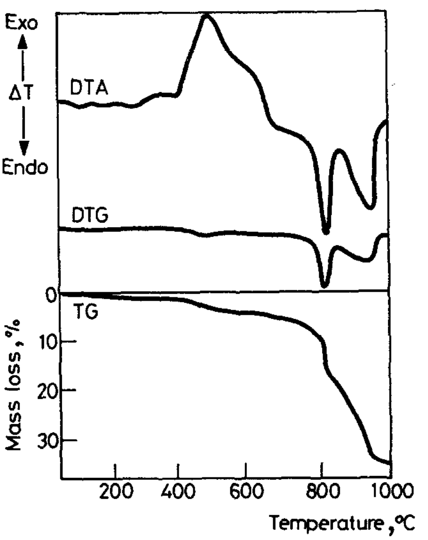

Fig. 3 TG, DTG and DTA curves of tailings from Boleslaw area determined in flowing Ar. Heating rate 5 deg·min^{-1}

Conclusions

The main component of the tailings remaining after the flotation of lead and zinc sulphide ores originating from the Silesian-Cracovian deposits (Poland) is dolomite containing non-uniformly distributed isomorphic admixtures of Fe(II) and Mn(II). The tailings from the Boleslaw area differ from those from the Trzebionka area in a relatively high content of iron sulphides and in the occurrence of siderite. The results will be helpful in the elaboration of methods of utilization of the tailings originating from the Silesian-Cracovian ore basin.

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