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V. 31 Estimation on Recovery Efficiency of Iron from Red Mud and Iron Concentrated Tailing by PIXE Method

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Nowadays, it becomes very important to utilize the resource effectively, because many natural resources have approached to the nearly exhausted state. Red Mud in aluminum refinery and iron concentrated tailing in copper smelting have been considered as the promising source of iron.

It has been developed the preparation process of high purity iron[1,2] by anion exchange method in a medium of hydrochloric acid solution. This process can be easily applied to the recovery of iron from red mud and iron concentrated tailing. In this report recovery efficiency of iron from the industrial by-products by acid leaching as a first step of the recovery process is estimated by PIXE method.

Leaching was carried out with 9N-hydrochloric acid in a water bath for about 1 hr and then the leaching solution was filtrated. Source materials and the filtrated residue of powder shape oxide were analyzed. Experimental conditions are as follows; the energy and the current of incident proton beam are 3 MeV and about 1 nA, and backing material is 10 μm thick mylar film.

X-ray spectra of iron concentrated tailing and the filtrated residue are shown in Fig. 1. As regards obtaining quantitative information from these spectra, the correction by the absorption through the samples is important, judging from the diameter of the powder specimen and the detected elements.

Assuming that each grain is sphere, mean thickness P is estimated from the radius of sphere r_m as $P = (\pi r_m)/2$. For the mean thickness P, the correction factor F_s is calculated as

$$F_s = \int_0^P \exp(-\mu\rho x)dx \Big/ \int_0^P dx = [1-\exp(-\mu\rho P)]/(\mu\rho P), \qquad (1)$$

where μ and ρ are the mass absorption coefficient and the density of the sample. As well known, the mass absorption coefficient is expressed as $\rho^{-1}\sum_j c_j\mu_j^i$, where c_j and μ_j^i is the concentration of constituent element j and the mass absorption coefficient of j element for K X-ray emitted from i element.

Since the real values of c_j are unknown at first, F_s can not be determined. As the zeroth approximation, c_j^0 is estimated from the peak area of the detected constituent elements after correction except F_s. On using c_j^0, F_s^1 is calculated by eq. (1) taking into consideration the absorption effect by main six metallic elements and oxygen with corresponding concentration in usual chemical oxide formula. Applying correction using F_s^1, c_j^1 is calculated. The correction by F_s was carried out until the obtained values converged.

The densities of the samples were measured by means of Archimedes' method.

Grain size of the samples was determined from the observation with scanning electron microscope.

Figure 2 shows the typical relation between the normalized peak area corrected by F_s^n and the number of iteration n. It is known that iteration more than three times gives a constant value. The analytical results are shown in Table 1. It is found that iron is the main element extracted in the leaching process.

References

1) Isshiki M. and Igaki K.; Trans Jpn. Inst. Met. 18 (1977) 412.
2) Isshiki M. and Igaki K.; Tech. Rep. Tohoku Univ. 44 (1979) 331.

Table 1. Composition of starting materials and filtrated residues of red mud and iron concentrated tailing. * Result of Na_2O is the data given by supplier.

(wt %)

		Na_2O*	Al_2O_3	SiO_2	S	Cl	K_2O	CaO	TiO_2	Cr_2O_3	Mn_2O_3	Cu_2O	PbO	ZnO	Fe_2O_3	Fe_3O_4
Iron concentrated tailing	Starting material	-	-	30.0	0.41	-	0.10	0.60	0.34	0.09	0.13	0.37	0.18	1.58		66.2
	Filtrated residue	-	-	89.8	0.97	0.10	0.98	2.4	0.20	-	-	-	0.85	0.40		4.3
Red mud	Starting material	6.8	9.4	20.9	0.23	1.1	0.08	3.2	10.9	0.06	0.03	-	-	-	47.3	
	Filtrated residue	-	9.9	52.2	-	0.15	1.0	0.15	33.2	-	-	-	-	-	3.4	

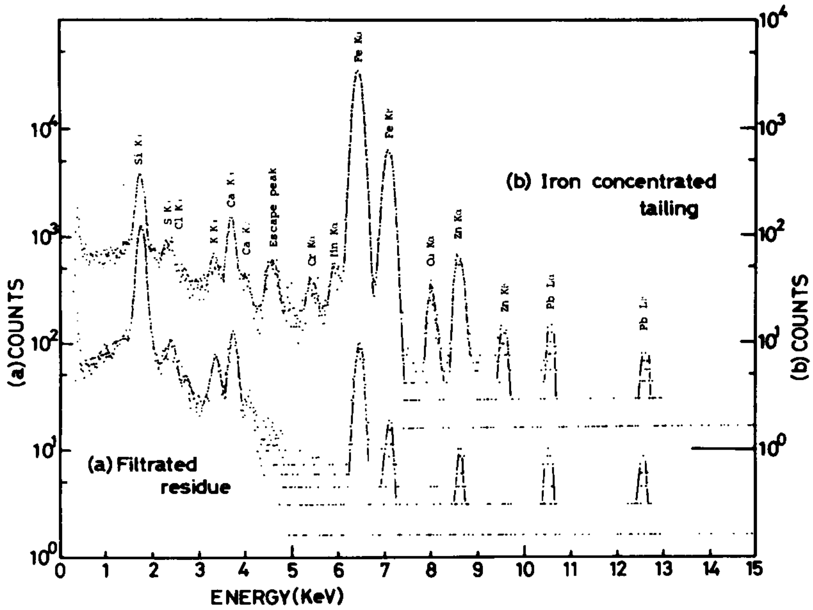

Fig. 1. X-ray spectra of iron concentrated tailing and filtrated residue.

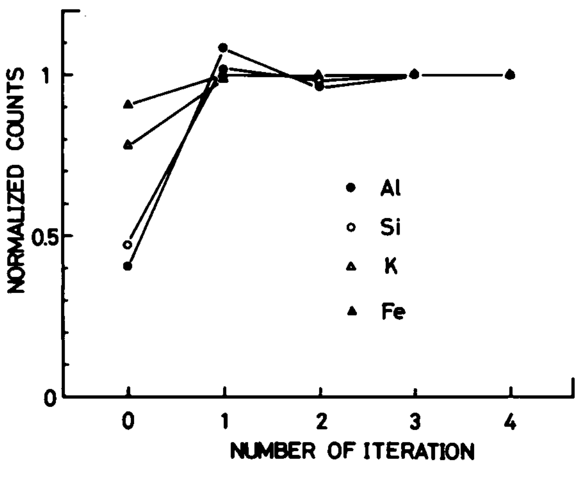

Fig. 2. Typical relation between the number of iteration of correction by the absorption through sample and X-ray peak area normalized by that of 4th iteration on filtrated residue of red mud. r_m and ρ are 7 ± 3 μm and 2.78.