Nitric acid technology for processing magnetic production waste

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At present, conventional methods for processing magnetic waste (both “dry” and water” technologies) are not always applicable under the conditions of industrial rare-earth element production. Our work proposes a novel approach to magnet recycling using nitric acid that can be implemented at existing industrial sites.

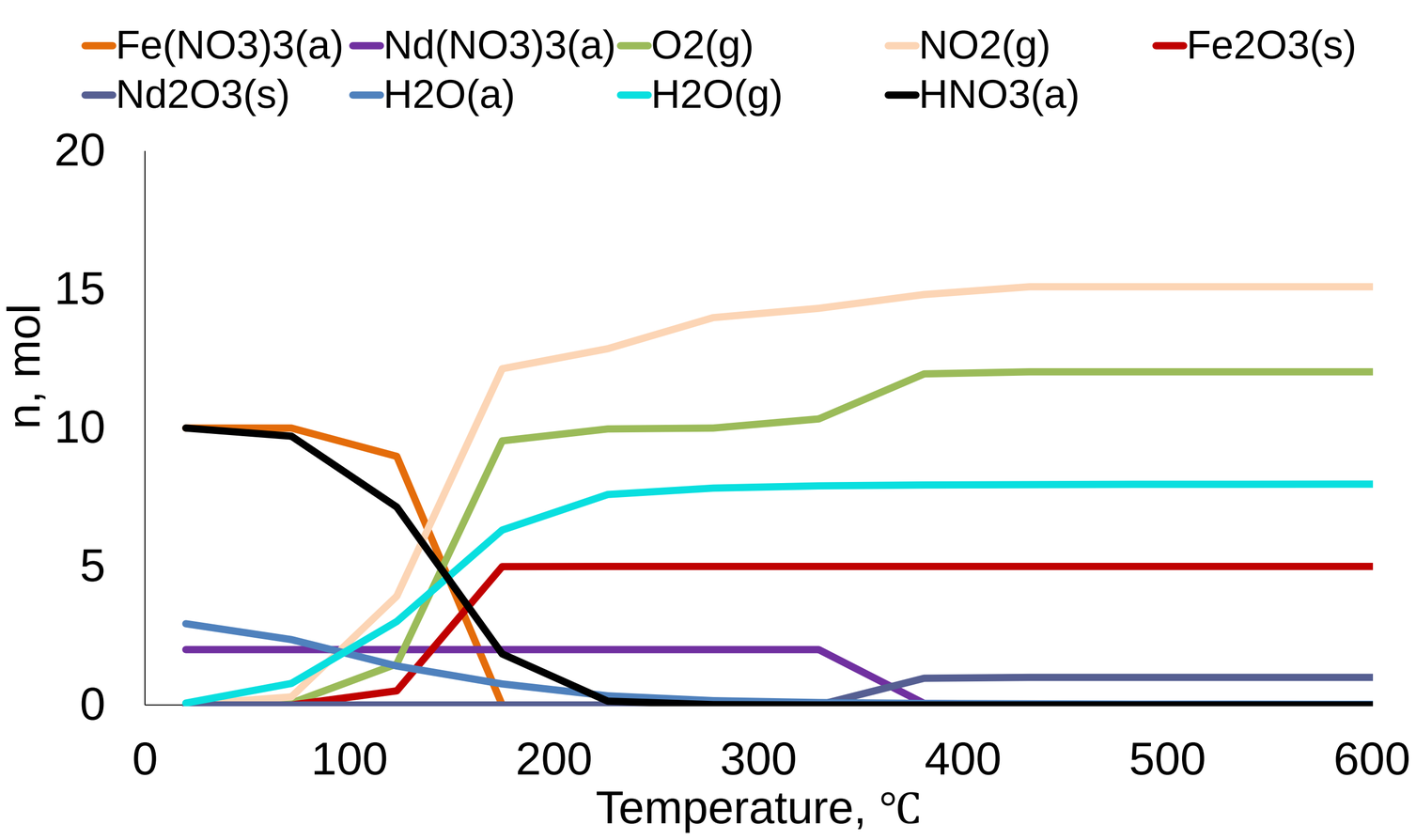

Fig.1. Computer simulation of the system

Based on the simulation data, it can be concluded that as the temperature increases, the amount of $Fe(NO_3)_3$ decreases, indicating its decomposition. At the same time, the quantities of gaseous oxygen (O_2) and nitrogen dioxide (NO_2) rise markedly, which is typical for the thermal decomposition of nitrates. The formation of iron oxide as Fe_2O_3 in the 130 °C–180 °C range—and its unchanged level above 180 °C—indicates that this is its final form under the conditions studied.

Following a series of laboratory investigations, baseline data were obtained for the design of industrial-scale installations for magnet recycling and nitric acid regeneration.

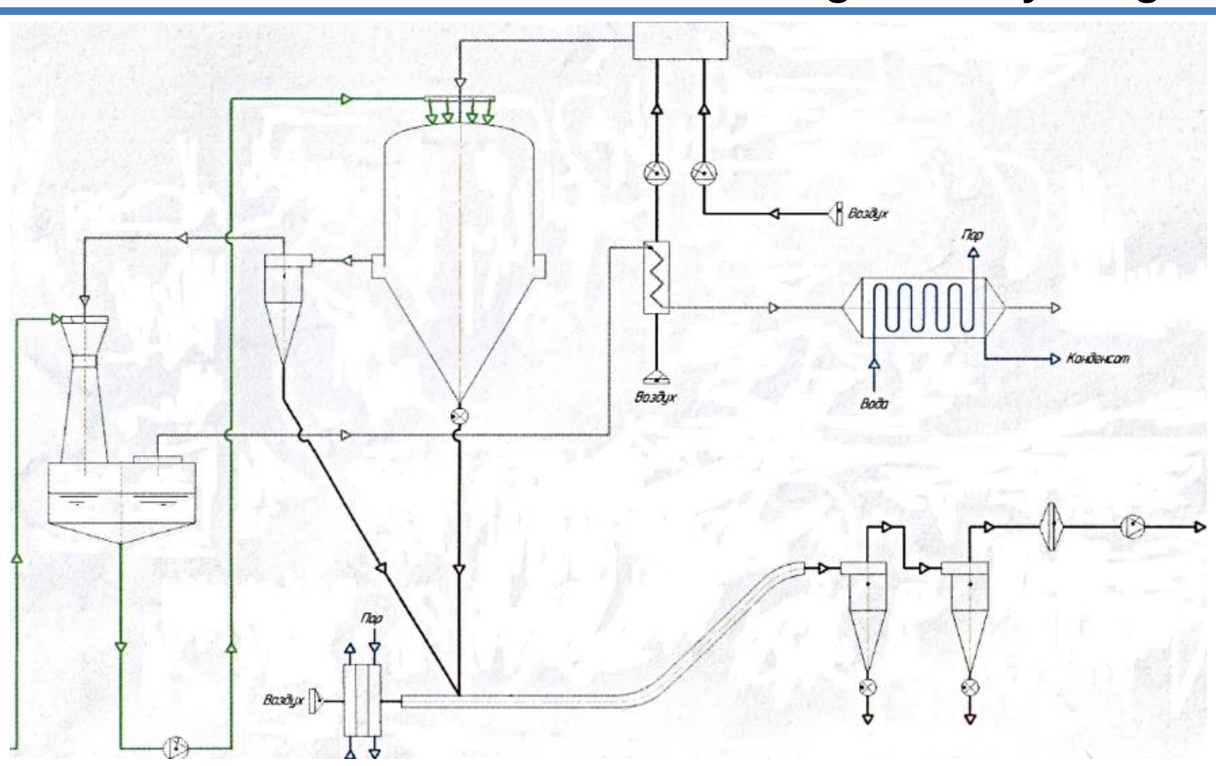

Fig.2. Thermal Decomposition of Iron Nitrate unit

The nitric-acid dissolution unit for permanent-magnet production waste operates on the principle of continuously and selectively transferring iron from the leach liquor into the oxide phase. To this end, the facility shown in Figure 2 is employed, fully meeting the requirements of the process.

In order to minimize costs, a nitric acid regeneration unit, as shown in Figure 3, has been proposed.

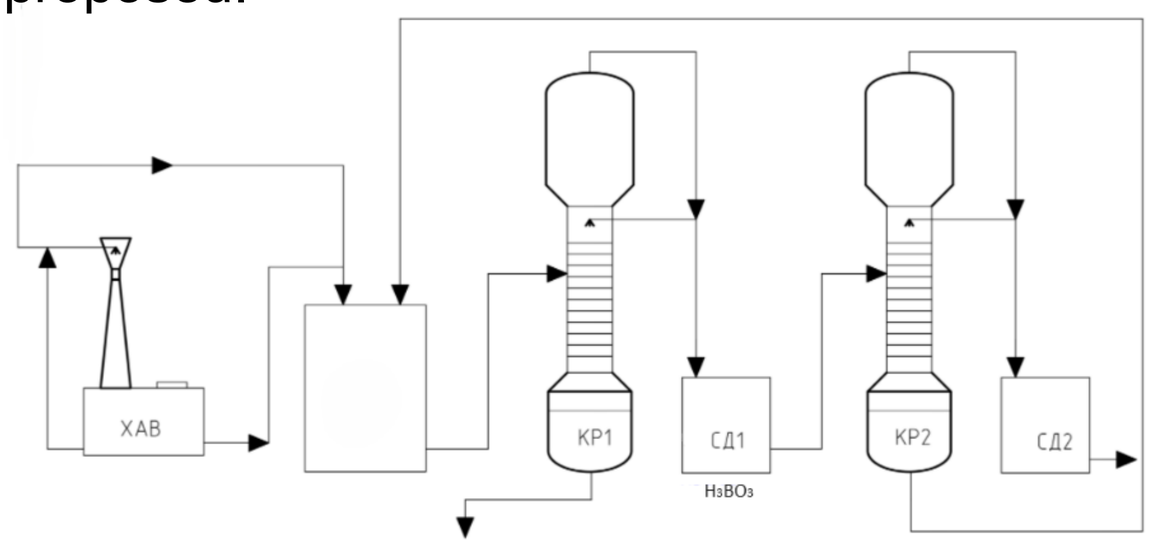

Fig.3. Nitric Acid Regeneration unit

In addition to regenerating nitric acid, the unit shown in Figure 2—whose operation is based on Reactions 1 and 2

$$4NO + 2O_2 = 4NO_2 \quad (1)$$

$$4NO_2 + O_2 + 2H_2O = 4HNO_3 \quad (2)$$

also simultaneously produces technical-grade crystalline boric acid with a yield of at 70 %.