The use of antimony as flame retardant in plastic products nowadays plays a major role in the antimony processing industry with antimony accounting for over 70% of today’s worldwide antimony consumption [1]. China holds a nearly monopolistic pressure to the market, leading to an uncertain situation regarding the Sb-price as well as the availability of antimony for western industrial nations [2]. Therefore the European Union – for the second time – listed antimony as one of the critical raw materials [3]. The project aims to develop a process for antimony trioxide winning directly from Sb-bearing residues. The product has to be marketable in the future-oriented industry. The aim of the project is to develop a process for antimony trioxide winning directly from Sb-bearing residues. The product has to meet the strict regulations of plastic industry (Fig. 2) to be applicable in this sector.

The Sb-bearing drosses originate from pyrometallurgical lead refining. After decopperization, tin, antimony and arsenic are removed by oxidation via air injection (Softening: consisting of PbO and Sb2O3 can be produced. However kinetic disadvantages cannot be overcome. More distinctive separation of the impurity oxides in this process step leads to better fuming conditions in the following process step. Antimony-rich drosses from industrial lead refining usually contain ~30 Wt.-% of antimony and ~60 Wt.-% of lead in oxide form.

Figure 3: Origin of Sb-bearing drosses in lead raffination

Figure 4: Calculated vapor pressure ratios as function of temperature and dross composition

Figure 5: Fuming reactor at IME

Figure 6: Fuming trial (lid open)

Figure 7: xAmOx condensates in different qualities

Figure 8: Experimental vapor pressure ratio at 800°C as function of dross composition

Thermochemical boundaries for fuming of qualified antimony while from drosses are evaluated in the forefront of experimental investigations through detailed thermochromic modeling in the Sb2O3-PbO system. Initially activities and vapor pressures are calculated from literature data. Then partial pressures are calculated at given temperatures and compositions. From these values a partial pressure ratio of Sb2O3 to PbO is determined. This also describes the molar Sb2O3 to PbO ratio in the condensate quality as: 

\[ f = \frac{p_{Sb_2O_3}}{p_{PbO}} \]

Figure 8 shows that unconditioned drosses do not fit these boundaries. Preconditioning of the droses before fuming therefore is inevitable.

Experiments with synthetic drosses describe vapor pressure behavior in the binary PbO-Sb2O3 system without the effects of accompanying oxides. Figure 8 shows experimental results in comparison to the calculations. The experiments clearly show similar vapor pressure behavior with slight absolute offset. However they also confirm the possibility to fume qualified Sb2O3 from the binary system with minimal changes of the dross requirements.

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