Treatment of shredder residue with MWIP^{plus}

"Management summary"

Starting position, objectives and approach

In Switzerland, the co-incineration of shredder residue (SR) in municipal waste incineration plants (MWIP) is regarded as a proven, economically and ecologically defensible, technically sound disposal solution. However the concentrations of toxic heavy metals in SR are higher than in waste. SR is therefore classified as special waste. Shredding operations process various metal-rich wastes together with end-of-life vehicles. The pollutants in the resulting SR stem only in part from end-of-life vehicles.

It was the remit of this study to ascertain the availability of ready-to-use technologies that would optimise SR co-incineration in MWIPs ("MWIP^{plus}"). The prime objective is to reduce the additionally-introduced pollutant burden in the form of heavy metals. In principle, there are measures prior to and after MWIP treatment that can address this. The aim of pre-treatment is to make the pollutant levels of SR prior to thermal processing in the MWIP more similar to those of municipal waste. Post-treatment attempts to recover the heavy metals from the MWIP residues (slag, filter ash).

The pollutant content in SR was firstly compared to the respective concentrations in Swiss waste, as already publicised in literature. In order to be able to also estimate which pollutant contribution was attributable to cars and which stemmed from other waste, the analysis data from separately shredded cars (ASR, automobile shredder residue) was compared to that from "normal" shredder residue (SR). A review was then undertaken to establish the significant improvements that were achievable with today's ready-to-use technologies. Various options were selected and then assessed with regard to ecological and economic criteria.

Key findings

1. Comparison of SR and municipal waste

A comparison of the most recent SR analysis data with earlier measurements shows that the elemental composition of SR has hardly changed in recent years. The problematical metals in SR are zinc (Zn, 2.10%), copper (Cu, 1.85%), lead (Pb, 0.26%), chrome (Cr, 0.16%), nickel (Ni, 0.12%), antimony (Sb, 230 mg/kg), cadmium (Cd, 77 mg/kg) and mercury (Hg, 3 mg/kg). In comparison to waste, the concentrations in SR of Zn, Cu and Ni are 15 to 18 times higher, and

that of Hg, Sb, Pb, Cd and Cr are 3 to 9 times higher. When co-incineration of SR (proportion 5%) takes place without pollutant reduction, the concentrations for each metal in the MWIP residues increase by a factor of 1.1 to 1.8 when compared with residues from incineration without SR. The calorific value (12.2 MJ/kg) and the PCB and Cl concentrations are comparable to those of municipal waste.

2. Comparison of mixed SR and ASR

ASR tends to have a slightly higher calorific value (18 MJ/kg) and a higher CI content (1.5%). The metal concentrations are slightly (Cu, Pb, Cd) to significantly (Hg, Zn, Cr, Ni) lower than in mixed SR. Hg and PCB levels are about equivalent to those found in municipal waste. Based on the analysis results, there is no reason change from the practice of processing ELV mixed with other scrap, as is carried out by the majority of shredder facilities.

3. Separation of pollutants

Mechanical processes

The mechanical processes available today allow lump-sized metals like Cu, steel and aluminium to be separated efficiently from SR as well as from MWIP slag after SR incineration.

Treatment of MWIP filter ash

During incineration, the volatile toxic heavy metals which are finely distributed in the SR become concentrated in the filter ash. The elements here include Zn, Pb and Cd. Zn and Pb are able to be extracted from the filter ash using an acidic wash. Cd is also able to be recovered from the filter ash. Since Cd will be eliminated from consumer goods in the medium term on account of its toxicity, its concentrations in SR will also fall in the medium to long term, in turn making recycling an unviable proposition. In more modern MWIPs, the treatment of filter ash with an acid wash is a standard practice.

Limits of pollutant separation

Some of the Cr and Ni present will be separated mechanically as alloying components of steels. Finely distributed fractions of these elements are largely transferred to the slags during incineration. The recovery of these would be an overly-costly chemical reprocessing of the slags.

4. Comparison of different treatment methods

The analysis of treatment options using a multi-criteria analysis method shows that a mechanical reduction of metals at a justifiable additional expense leads to an ecological improvement compared to current practice. In respect of the total benefits derived, the pre-treatment of SR in a simple mechanical plant is equivalent to the reprocessing of the wet and dry slag from the MWIP. The more involved options involving largely mechanical reprocessing come out more poorly in the end due to their considerably higher costs in relation to their ecological additional benefits.

As part of the current Revision of Technical Ordinance on Waste (TOW), mandatory mechanical slag reprocessing for all MWIP slags is under consideration. Should the TOW be amended to this end, the option of mechanical metal separation prior to incineration would become unnecessary.

Conclusion

The co-incineration of SR in the MWIP can continue to be recommended as a suitable disposal practice. It should nevertheless be improved ecologically through comparatively technically simple metals reduction processes ($MWIP^{plus}$). These include acidic washing to recover Zn (and in the longer term also Pb) from the filter ash and mechanical slag reprocessing to recover Fe, Al and Cu. These measures will serve to reduce the level of pollutants in the SR and in the municipal waste.