Contamination in plastic recycling: Influence of metals on the quality of reprocessed plastic

The global consumption of plastic continues to increase, and plastic recycling is highlighted as crucial for saving fossil resources and closing material loops. Plastic can be made from different polymers and contains a variety of substances, added intentionally to enhance the plastic's properties (metals added as fillers, colourants, etc.). Moreover, plastic can be contaminated during use and subsequent waste management. Consequently, if substances and contaminants are not removed during recycling, potentially problematic substances might be recycled with the targeted polymers, hence the need for quantitative data about the nature and presence of these substances in plastic. Samples of selected polymers (PET, PE, PP, PS) were collected from different origins; plastic household waste, flakes/pellets of reprocessed plastic from households and industry, and virgin plastic. Fifteen selected metals (Al, As, Cd, Co, Cr, Cu, Fe, Hg, Li, Mn, Ni, Pb, Sb, Ti, Zn) were quantified and the statistical analysis showed that both the polymer and origin influenced the metal concentration. Sb and Zn were potentially related to the production stage of PET and PS, respectively. Household plastic samples (waste and reprocessed) were found to contain significantly higher Al, Pb, Ti and Zn concentrations when compared to virgin samples. Only the concentration of Mn was reduced during washing, suggesting that parts of it was present as physical contamination. While most of the metals were below legal limit values, elevated concentrations in reprocessed plastic from households, aligned with increasing recycling rates, may lead to higher metal concentrations in the future.