Environmentally Benign Manufacturing: Integrated-model-based Process Modification

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Most effective waste reduction technologies implemented in electroplating plants are essentially for in-plant waste treatment and then material reuse. While the waste that leaves the plant (end-of-plant waste) can be truly reduced, the waste generated from plating lines (end-of-line waste) remains the same. This is certainly a passive approach for source reduction. The minimization of end-of-line waste is always risky, however, because it is very likely to exert a reverse impact on production. Nevertheless, end-of-line waste minimization should be our focus because it focuses on waste sources. In this direction, the fundamental basis of process-focused pollution prevention (P2) is the deep understanding of the design and operation of a plating line. This paper introduces a model-based design methodology that can be used to evaluate the design optimality of multi-stage cleaning and rinsing systems from the environmental and economic points of view. An optimal solution will be derived using sophisticated mixed integer nonlinear programming (MINLP) techniques. The methodology has been successfully used to modify an existing plating line. The resultant process can reduce two rinsing tanks, while cleaning and rinsing quality can be ensured. The chemicals in wastewater and the volumetric flowrate of wastewater in the new design can be reduced by 10 and 15 percent, respectively. This design methodology is general so that it is applicable to any plating line.

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