

## EVALUATION OF TWO PHARMACEUTICAL WASTE SOLVENT VALORIZATION TECHNIQUES

Geert Van der Vorst<sup>a\*</sup>, Pilar Swart<sup>a</sup>, Wim Aelterman<sup>b</sup>, Andres Van Brecht<sup>c</sup>, Eddy Graauwmans<sup>c</sup>, Herman Van Langenhove<sup>a</sup>, and Jo Dewulf<sup>a</sup>

<sup>a</sup>Research Group ENVOC, Ghent University, 9000 Gent, Belgium

<sup>b</sup>Johnson & Johnson PRD, Janssen Pharmaceutica nv, 2340 Beerse, Belgium

<sup>c</sup>Indaver, 2800 Mechelen, Belgium

Sustainable development is an important issue in the fine chemical and pharmaceutical industry. Tools for the evaluation of the environmental sustainability of processes and products are mainly dealing with emission and toxicity type of indicators. However, regarding the integral resource consumption of products or processes, these tools still show some limitations. First, resource consumption is mostly split up into mass and energy requirements. When looking to the overall production chain, many of the resources can fulfill both functions, especially in the chemical industry where fossil fuels serve as the feedstock for e.g. solvents but also to deliver heating energy. Second, a narrow system boundary approach is mostly used when evaluating products and processes. It is common practice to use the gate-to-gate system boundary, resulting in the omission of the overall resource intake upstream and downstream of the production plant itself. Both limitations can be overcome by combining exergy analysis with the life cycle assessment (LCA) approach<sup>1</sup>.

In this study, the integral resource consumption of two treatment alternatives: an on-site distillation process and an off-site incineration process are evaluated and compared by using an exergetic life cycle assessment. In case of distillation, the main objective is to reuse the solvent, whereas with incineration the solvent acts as a fuel to incinerate low calorific hazardous waste (LCHW) and serves for electricity and heat production. Both disposal options thus use the waste solvent as a resource. The evaluation is done for two typical pharmaceutical waste solvent streams: toluene (TOL) and dichloromethane (DCM) which are normally distilled. Data for the distillation is gathered from Janssen Pharmaceutica, Belgium, part of Johnson and Johnson. Data for the incineration process is gathered from Indaver, Kallo, Belgium. Indaver makes use of waste solvent of Janssen Pharmaceutica to perform incineration of LCHW with energy (heat and electricity) recovery. This study is based on data of the hazardous incineration installations at this moment. In the near future, investments are planned to increase the efficiency of the energy recuperation (steam and electricity) over the next coming years. It also has to be stressed that in practice, only solvents go to incineration which cannot be distilled due to the type and degree of pollution/composition of the solvent. If distillation is not feasible, then such solvents are sent to incineration with energy recovery, according to the EU directive 2006/12/EG.

As both treatment options deliver a different set of products and services, scenarios according to the system enlargement principle, have been constructed allowing a comparison of both techniques based on the following functional unit: Treatment of 1 kg waste solvent + Treatment of W kg hazardous waste + Delivery of X kg solvent + Delivery of Y kJ heat + Delivery of Z kJ electricity. W, X, Y and Z depend on the waste solvent's composition and its properties.

For TOL as well as for DCM, distillation is the preferable treatment option from a resource point of view. Respectively 17% and 66% less resources are required than for the incineration process<sup>2</sup>. It can be concluded that the lower heating value of the waste stream, the recyclability

(efficiency of the distillation process) and the efficiency of the fresh solvent production are major contributors to the overall results. From this research, it can be concluded that taking into account all the mass and energy inputs over the whole life cycle and quantified in exergy values, results in better view of the real resource consumption related to a specific treatment option. It can also be concluded that other life cycle impact assessment methods e.g. focusing on emissions can give extra information and other perspectives for such an evaluation. This can only result in better decision making when choosing the environmentally best treatment option for specific waste solvents.

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### **References**

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