Socio-economic analysis based on a life cycle perspective: the comparison of existing and emerging production process for trimethyl phosphite

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1. Introduction

In order to demonstrate the sustainability of the novel process for the production of TMPi that will benefit the environment and human health, a number of different analysis were performed within the EU Life project TRIALKYL, such as the health assessment for hazardous materials and environmental impact assessment based on life cycle assessment.

The objective of this Socio-Economic Analysis (SEA) is to determine whether the benefits of continuing using a continuous tertiary amine (TEA) process for the production of TMPi outweighs the risks to human health and the environment. The purpose is also to compare the risks and benefits of the two alternative TMPi production processes.

In this SEA study, the existing TEA production process is compared with the new TRIALKYL process for the production of TMP. The current evaluation is based on laboratory data and design of the pilot line, while the final evaluation will be based on industrial data on pilot line.

2. Materials and methods

Socio-economic analysis (SEA) is a methodology developed for chemical risk management and decision making derived from tools like the Cost benefit analysis, or the Multi-criteria analysis by the OECD 2002 and 2006 [3,4]. Since the latest ECHA guideline for SEA in 2011 [1], a number of studies have been performed, while seldom with a life cycle perspective and seldom on production processes.

This socio-economic analysis is based on an earlier Life cycle assessment on the production process of trimethyl phosphite (TMPi) [6]. Besides economic, health, environmental and social impacts, this socio-economic analysis is also including the risk of fire/explosion and life lost.

Trialkyl phosphites are important intermediates in the chemical industry in a large variety of applications, including crop protection, flame-retardants and plastics production. Among the existing technologies for the production process of TMP there are the tertiary amine process (TEA) and the transesterification process. Among the new innovative technologies, there are the TRYALKYL process, part of this comparison and the EU Life project TRIALKYL in 2014 [2].

3. Results and discussion

The socio-economic analysis SEA includes mainly economic, health, environmental and social impacts in accordance to the latest ECHA guidelines for SEA.

The results of the SEA analysis are economic benefits and risk presented as scenarios, such as the “non-use scenario” for the Trialkyl production process and the “applied for use scenario” for the TEA production process. The socio-economic benefits and risks/costs associated with the continued use of the TEA based process are summarised in key parameters including risk of fire/explosion and life lost presented in table 1. Further details can be found in the project report [5].

The benefits of this continued use of the TEA based process are the costs which can be avoided when not adopting the Trialkyl process alternative. These benefits are estimated to be approximatively €7 082 420 and the cost of cost of continued use to be €20 Mill.

Comparing the benefits and the costs it is evident that EU society benefits significantly from the shift to the Trialkyl process over the period considered.

Type of impact	Benefits of continued use	Cost of continued use	Net impact of continued use
Economic	Avoid Capital cost of Trialkyl: € 1.5 Mill Avoid Loss of production: €590,000	Higher operational costs OPEX: €36.000/yr	A net economic benefit
Human Health	Avoided risk of Trialkyl chemicals €25,000/yr Avoid Trialkyl air pollution: €20,000/yr	Risk of TEA chemicals: €262,000/yr Air pollution: €266,000/yr	A net economic cost
Environment	Avoid Trialkyl Climate impact: €19,000/yr Avoid Trialkyl Water: €1,180,000/yr Avoid Trialkyl eutrophication: €5,000/yr Avoid Trialkyl aquatic toxicity: €44/yr	Climate: €322,000/yr Water: €3139,000/yr Waste Water: €367/yr Eutrophication: €43,000/yr	A net economic cost
Fire/explosion Risk	Avoid Trialkyl methanol release/fire: €7.7E-3/yr	Methanol release/fire: €6.9E-3/yr	Likely to be no significant change
Social	Avoided short term unemployment impacts	No significant change	Likely to be no significant change

Table 1: Key parameters for the socio-economic benefits and risk/costs.

4. Conclusion

In conclusion, the socio-economic analysis based on life cycle perspective are useful for the health and environmental assessment and beneficial for the understanding of chemical risk management and decision making. So far, the results have shown that despite the cost of a new production plant, the EU society benefits significantly from the shift to the Trialkyl process due to the improved benefits within human health and the environment.

5. References

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