TECHNICAL NOTE

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LIFE CYCLE ASSESSMENT OF PVC PIPES

Introduction

Life cycle assessments or LCA's are used to determine the environmental impact of products used to perform a particular function. The assessment evaluates the impacts from 'cradle-to-grave'. That is, every stage in the life of a product is included, from extraction of the raw materials and energy required, through all of the various stages of manufacture and use, and ultimately the disposal of the product.

Various other environmental comparisons are often made between products, such as energy used in manufacture or greenhouse gas emissions. While this information may be of interest, it can lead to incorrect conclusions being drawn about alternative products as they are not based on a complete picture of environmental impacts.

Standardised LCA's

The development of the LCA as a tool to evaluate environmental impacts is ongoing, and to date, there is no universally accepted methodology for performing an LCA. However, work is continuing in the International Organisation for Standardisation (ISO) on a series of environmental management standards which will ultimately include a standard approach to LCA. The ISO 14000 series of standards are targeted for publication at the end of 1997 and it is expected that there will be much debate on this subject in the future.

Elements of an LCA

The first stage of an LCA is to define the objective, scope and the boundaries of the assessment. It is generally accepted that this is to be done in terms of the function that the product performs rather than the product itself. Hence, an LCA would consider delivery of drinking water to a household from a reservoir, rather than simply the production of pipes used for this purpose.

The second stage involves gathering of the data to be used in the assessment. This may involve decisions about how to apportion energy and emissions between products. For example, in the production of PVC, the electrical energy in the chlor-alkali process must be shared between the two products, chlorine and caustic soda. Various approaches have been taken including sharing this arbitrarily on the basis of relative mass or on the basis of the monetary value. These result in quite different divisions and obviously have a significant effect on the final outcome.

The third stage of an LCA involves an assessment of the data by categorising the effects into various environmental impacts. As an example, typical classifications include, Global Warming Potential and Human Toxicity Potential.

Since the results of an LCA are dependent on the scope, data and methods used, an improvement analysis is often carried out. This looks at the sensitivity of the results to changes in the data or methods. It may also identify changes which could be made to improve the environmental outcome of a system. Obviously, the technical feasibility of any suggested changes needs to be considered as well.

PVC pipes

A recently published LCA entitled, 'Environmental Life Cycle Assessment of Gas Distribution Systems.' was carried out

by GASTEC, the Dutch organisation for gas distribution and CML (University of Leiden) in the Netherlands. This study compared three pipe materials in the gas distribution network. These are Nodular iron (Ductile iron), PE 80 Polyethylene and PVC. The report considers the following impact assessments:

- Photochemical Oxidation Creation
- Aquatic Ecotoxicity
- Global Warming Potential
- Acidification Potential
- Abiotic Depletion Potential
- Human Toxicity
- Nutrification Potential
- Odour Threshold Limit
- Ozone Depletion Potential
- Energy Content

The overall conclusion of the analysis was: 'In general, nodular iron scores worst. On a large distance PE-80 and PVC follow, where PVC scores the best. The exceptions are found in the smell (OTL) score: PVC scores slightly higher than PE-80.'

Various sensitivity analyses were carried out. In most cases, these did not influence the ranking of the materials.

An English version of the GASTEC report 'Environmental Life Cycle Assessment of Gas Distribution Systems' can be ordered at:

GASTEC NV
PO Box 137
7300-AC Apeldoorn, The Netherlands
Phone ++ 31 554 393 393
Fax ++ 31 554 393 449

for a cost of DFI 100

Other considerations

One of the recommendations from the GASTEC report was to consider the pipe cross section, since the mass of material used largely effects the environmental impact of the product. These developments have already occurred in the case of PVC with the advent of material efficient PVC pipes such as Oriented PVC for pressure applications and structured wall pipes like Ultra-Rib for non-pressure applications. It is clear that considering these products will further improve the environmental status of PVC pipes.

In the GASTEC report, the use of scrap as an input in the manufacture of ductile iron pipe is 'considered as "for free" without any environmental impacts'. However, it can be readily argued that an acceptable system for sharing the energy and emissions between subsequent lifetimes should be devised. This is obviously a complex issue and it is certain that there will be much lively debate before a universally accepted, standard approach is adopted.

Conclusion

For environmental comparisons between products to be useful in making a balanced materials selection, it is essential that they include all of the environmental impacts 'from the cradle to the grave' as is done in a Life Cycle Assessment. One such study on gas distribution systems found PVC pipe had the lowest impact on the environment when compared with a number of functionally equivalent alternatives.

It is obvious that environmental comparisons between products are only relevant if the same terms of reference are used for all materials. Hence, the conclusions drawn by comparisons which are not done using the LCA approach, and which quote various sources for their data without qualification should be used with caution.

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www.vinidex.com.au

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