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Ref. :

Van : VITO

Bijlage(n) :

Aan : TNO

Kopie :

Betreft: Comments of final draft report LCA of thermal treatment of waste streams in the clinker production in Belgium

- Titel: better to say "LCA of thermal treatment of waste streams in clinker kilns in Belgium", since the methodology makes abstraction of the fact that clinker is produced.
[Good point; we will change the title.](#)
- Summary: "A second positive effect is the fact that cement kilns do not have emissions of toxic substances to the water, whereas rotary kilns do have such emissions": the rotary kiln has a wet flue gas cleaning system followed by a waste water treatment removing these toxic substances from the water. Emissions to water are clearly overestimated by using very old LCA data (part of these data go back to 1988). In the previous LCA by TNO, about 10 years ago, specific distribution factors were used for the Indaver rotary kiln. These show emissions that are much lower (air and water). Why are these not used? We already questioned the results for incineration in the previous comments, but there was no reaction to this? See further on [It was preferred to use 2006 data from Indaver, however as these data were not available for this study, it was agreed to use ecoinvent data as a startingpoint for the calculations. Nevertheless, we agree that the used data for the incinerators partly are a little outdated. We therefore have made an additional sensitivity analysis on this point – see paragraph 4.3.7. However Hg and other metal emissions have a limited contribution to the results, and other impacts \(CO₂ emissions\) and the avoided energy determine the outcomes.](#)
- The method used was not questionable by the expert panel. On different occasions, comments were made pointing out that the energy efficiency of the cement process is not taken into account, while the efficiency of energy recovery for the waste incinerators is determining the outcome of the LCA. At least, these issues could be addressed in the report. The study concludes that more CO₂ is saved by incinerating the waste in the cement kilns compared to the incinerators. This could be misleading. The reduction potential for CO₂ will probably be much higher if the energy efficiency of the cement kilns is considered. The results suggest that CO₂ emissions are reduced by treating the waste in a cement kiln in stead of an incinerator. But, maybe more CO₂ emissions could be reduced by improving the average energy efficiency of Belgian cement kilns ... These issues are not addressed in the report.
[That is right; energy efficiency was outside the scope of the project. In the goal and scope of the report it is explained in more detail that energy efficiency is not relevant in this study, because in this study the thermal treatment of 1 ton of waste is the functional unit, and not the production of 1 ton of cement clinker. What is relevant in this study for clinker production, is the difference in CO₂ emission between the treatment of 1 ton of waste and the use of a comparable amount of primary fuel \(pet coke or coal\). And for waste incinerators this is the difference in CO₂ production between the incineration of one ton of waste and the production of an amount of electricity / heat in a Belgian power plant, equivalent to the amount of electricity / heat that is produced in the incinerator, when treating 1 ton of waste. \(As was already explained on pages 5 and 6 of the report\).](#)

- The aggregation of the results is done, even though OVAM and VITO did not agree. There is no clear distinction between the ISO-conform LCA and the aggregation, although this was agreed upon earlier on in the project. This is not necessary after all, according to TNO and Neosys, because the report is intended for a limited public. VITO does not agree with this. If Febelcem is the only reader and user of the report, the argument holds, otherwise not.

The study-approach is largely in harmony with ISO guidelines for LCA. A review panel has followed the study as it is a (public) LCA comparison. Any LCA needs interpretation of the results. LCA experts within the review panel have different interpretations on ISO guidelines as to what is allowed in a public comparison study. According to VITO weighting is not allowed, according to Neosys weighting needs to be transparent but is necessary for interpretation.

In the Annex TNO publishes the

- unweighted characterised results and
- the procedure (or method) that is used to derive weighting factors
- the weighting factors per impact category and
- the weighted results

By including this information in the report, we believe we are in line with the ISO descriptions on interpretation of LCA for comparative assertions disclosed to the public (requirements following from grouping or weighing of the results) - as there is transparency on the selected weighting method, the weighting factors and the influence of weighing on the (unweighted) results.

- p.6: To follow the guidelines for LCA and to ensure the quality of the LCA study, the study is conducted in consultation with an expert panel. This sentence should be removed from the report. The report could say that there was an expert team and could then refer directly to the annex. This way, all relevant information on the expert team and their comments are collected. The composition of the expert panel could then be listed in this annex. Our conclusion is that:
 - Deadline for serious comments on draft report was 19/07. Since the expert of VITO was absent from 9-13 /07, it was not feasible to do this. This deadline was decided on in the absence of VITO.
 - Distribution coefficients for incinerators were only available on 31/07, more than 10 days after the deadline to formulate fundamental comments. These data (and other) were asked by VITO for a long time. By sending them too late, the ISO-guidelines were not followed and the expert panel could not help to ensure the quality of the LCA.

Leaving that sentence and the following in the goal and scope of the study would be misleading for the public reading the document. We really want to avoid such misunderstanding, because the report would be different if we were really consulted during the study.

The sentence in the report will be revised. Furthermore in the report there is a reference to this Annex with your comments. It is right that the study had to be performed in a stringent time frame. However, all experts were in the opportunity to bring in comments. Nevertheless, not all comments of individual experts led to changes in the report.

- Several comments and recommendations from VITO were not taken into account although (for example, NO_x emissions are not taken into account in de emissions of the cement kilns and the emissions of petcokes or coal = misleading and incorrect: this should have been corrected on the figures). This is only one example. Stating that our presence in the expert panel ensures the quality of the LCA is incorrect.

We are not in the position to assess the added value of the presence of VITO in the expert panel. We will therefore change that part of the sentence in the report, and state that the aim of consulting the expert panel was to improve the quality of the study.

- The report repeats on several occasions that it is not realistic to assume that solvents/waste oils replace light oil in waste incinerators. We have repeated on several occasions that these waste products are used to obtain the right process conditions. If they were not available, light oil would be used. So, they avoid the use of light oil. They are not used for starting up, as is suggested on many occasions in the report. We have provided different references. Indaver would certainly confirm this, if they were to be contacted. Still, no corrections are made to the report?

Starting point is (and was) the actual situation in 2006. Furthermore, in the goal and scope it is explained that the approach to compare both systems is that of *marginal change*. From the year report of Indaver it can be learned that they already use waste oils as a supportive fuel. This is explained in chapter 2.2 of the report. So, if one ton of solvents / waste oils would be supplied extra to Indaver (a marginal change), this would most probably replace a ton of waste oil (as supportive fuel). This does not lead to any change in environmental impact. We do not believe that light fuel could be replaced; otherwise in practice Indaver would already have replaced all light fuel by waste oil.

- For the cement industry, one could also argue that waste is replaced by waste if the maximum amount of waste (according to the permit) is already being treated. In those circumstances, petcoke could not be replaced any further by waste.

Once again, the approach to compare the systems is that of marginal change. In case of the cement producers we asked them what they would replace if more waste materials would be supplied. Indeed, in one specific case, that of hazardous sludge, it would replace non-hazardous sludge (being more or less the same material, resulting in no change in environmental impact). In all other cases the waste would replace pet cokes or (in less cases) coal.

- Petcoke:
 - This is in fact a by-product or waste product from refining activities; Even if the petcoke is not used, these activities will continue and petcoke is still produced. Therefore, it does not seem correct to assign part of the environmental impact of the refining process to the petcoke? The use of petcokes will surely not result in a depletion of fossil fuels.
 - If it is not used by the cement industry, is it used elsewhere? Where? What emissions would these other processes produce

The approach of substitution of by-products like petcoke is often applied in the LCA field.

Even though it is a by-product, it has an economic value, and in that sense it is correct to assign part of the environmental impact of the refining process to the petcoke.

Beside a substitution of petcoke, each waste stream is also analysed for a scenario where coal is substituted. Coal is a product, and not a by-product. The results of the calculation with coal substitution point in the same direction as the calculations with petcoke substitution. The results are less positive, but the conclusions do not change.

- Filter cake: we repeat our question: why is it not dried before treatment? What's the difference with sludge? Filter cake has a lower heating value and a higher moisture content? This is clearly explained in chapter 3.2. One sentence in chapter 4.2.2. mistakenly was not changed; this is done now.
- Comparison of Indaver transfer coefficients from previous LCA study and used transfer coefficients in current LCA.

Table 3 Transfer coefficients of typical hazardous waste incineration

Element	Source	Air_emissions	Water_emissions	Solid residues
		%	%	%
H ₂ O	MSWI	100	0	0
O	MSWI	91,7	0	8,3
H	MSWI	100	0	0
C	UVB1988	100	0	0
S	Jahn2002	0,06/0.66%	95,7/17.9%%	4,28/81.44%
N ₁	UVB1988	4,6	7,93	0
P	Jahn2002	0,07	1,53	98,4
B	MSWI	12	15,1	72,9
Cl	Jahn2002	0,03/0.03%	99,8/96.7%	0,17/3.27%
Br	Jahn2002	0,02	99,8	0,17
F	UVB1988	0,05	26,6	73,4
I	Jahn2002	0,02	99,8	0,21
Ag	MSWI	0,0013	0,0073	100

As	MSWI	1,02E-06	0,01/0%	100/100%
Ba	MSWI	0,1	0	99,9
Cd	UVB1988	0,899/0%	10,2/0%	88,9/100%
Co	Jahn2002	0,07/0%	99,9/0%	0/100%
Cr	MSWI	7,39E-06/0%	0,32/0%	99,7/100%
Cu	Jahn2002	0,07/0.03%	4,29/0%	95,6/99.9%
Hg	UVB1988	4,02/0.05%	10,6/0.07%	85,3/99.88%
Mn	MSWI	5,45E-07	0,001	100
Mo	MSWI	0,02	0	99,8
Ni	Jahn2002	0,07/0.08%	20,5/0.00%	79,5/99.92%
Pb	UVB1988	0,331/0.09%	11,5/0.03%	88,1/99.88%
Sb	MSWI	3,89E-07	0,018	100
Se	MSWI	5,03E-07/0%	0,0118/0%	100/100%
Sn	MSWI	0,133	0,00133	99,9
V	MSWI	0,01	0,001	100
Zn	Jahn2002	0,07/0.02%	1,34/0.01%	98,6/99.97%
Be	MSWI	0,1	0	99,9
Sc	MSWI	0,05	0	100
Sr	MSWI	0,01	0	100
Ti	MSWI	0,1	0	99,9
Tl	MSWI	0,1	0	99,9
W	MSWI	0	0	100
Si	MSWI	0,233	0	99,8
Fe	Jahn2002	0,07	80,3	19,6
Ca	MSWI	0,167	0	99,8
Al	MSWI	0,156	0	99,8
K	MSWI	0,3	0	99,7
Mg	MSWI	0,138	0	99,9
Na	MSWI	0,941	0	99,1

10 years ago, less pollutants were taken into account. Concerning HF, such emissions are not measured (below measure limits) by Indaver, so it is not realistic to assume that these emissions would have such an important impact on the LCA results. Part of this information dates from 1988 (or older). This is very old. For the cement kilns, it was very important to use recent (2006) emission data. Why follow a different approach for both systems?

It was preferred to use 2006 data from Indaver, however as these data were not available for this study, it was agreed to use ecoinvent data as a startingpoint for the calculations.

Nevertheless, we agree that the used data for the incinerators partly are a little outdated. We therefore have made an additional sensitivity analysis on this point – see paragraph 4.3.7. Even though we cannot justify the data (because there is no reference), we have used your data for that purpose. The results show that Hg and other metal emissions only have a limited contribution to the results, and other impacts (CO₂ emissions) and the avoided energy determine the outcomes.

The main difference between 10 years ago and now for Indaver is the fact that they added a deNO_x installations. Minor differences are not known by VITO, but they may exist. The performance could only be improved, but not worsened.

As we have no data from Indaver(except the public data), TNO cannot judge the environmental performance of Indaver

Concerning the Hg emissions, special care is taken by Indaver: Hg is removed in the wet cleaning and then removed from the water by complexing the Hg into insoluble products. The last traces of Hg in the waste gas are removed by the dioxin filter. The same is true for other pollutants. They are removed from the waste gas and then removed from the water (that's why

they use the TMT and FeCl₃).

[See comment above \(just underneath the table\).](#)

The Cl emissions to water should be seen in the particular context of Indaver. They discharge into brak (semi salt) water in the Schelde. Therefore, they discharge NaCl without impacting that particular environment. Is this fact taken into account in the LCA calculations?

[Chloride emissions to water do not contribute to the environment impact assessment with CML or Eco-indicator 99](#)

All calculations should be adapted. We can only make this comment now, since these transfer coefficients were not sent to us before.

[See comment above \(just underneath the table\).](#)

- Similar information for the cement kilns is not available and can therefore not be evaluated by VITO. We are not able to play our role as independant expert.

[As was accepted by the expert panel, from an confidentiality point of view, the data of the individual cement producers were sent to TNO en Neosys only. The transfer coefficients calculated by TNO were reviewed by Neosys. Average environmental impact data are presented in Annex 5.](#)

- Transport: the subject of the study is -in our opinion- the treatment of Flemish waste. It is not correct to use the same transport distances for both systems (cement kiln and incineration)
[Transport is taken into account. Travelling distances for the thermal treatment of the wastes in cement kilns were determined, based on the real sources, specified by the cement producers. The used wastes mainly come from Belgium \(all directions\) and the North of France, the west of Germany \(close to Belgium\) and the South of the Netherlands. The transport distance from France to Indaver is slightly longer, from the Netherlands slightly shorter compared to the distance to the cement kilns. The difference for transports from Germany depends on the location of the cement kiln. The average net result is more or less the same for waste treatment at Indaver and for waste treatment in the cement kilns. For transparency reasons we have taken the same distance and transport means. Travel distances cannot be left out, however, because of the fact that the transport distances for the substituted fuels are not the same.](#)
- In the report there are copy paste mistakes. Also for the sludge it is stated that the same pre-treatment is assumed for the cement kilns and the incinerator. But, this was adjusted, no? So, this should be removed from the report.
[These mistakes are adapted in the report.](#)
- Why would the use of waste streams lead to a decrease of NO_x emissions. Is there a scientific hypothesis or explanation? Please explain?
[This is known from measurements in practice, and also from modelling exercises. The measurements mentioned in the report, were done at the ENCI plant in Maastricht \(Netherlands\). However, the actual data are confidential. As is explained in the report \(chapter 3.3\), most of the NO_x produced in a clinker kiln is not caused by the nitrogen from the raw materials or the fuels, and is therefore process intrinsic. This means that it will not change as a consequence of the marginal change of 1 ton of fuel. This will be explained more extensively in the report.](#)
- How are the NO_x emissions for the incineration kilns calculated? Use of an emission factor per ton waste (same value for each waste)? Or, are they calculated in function of the caloric value of the waste? Not clear from the report, so we cannot evaluate the method ...
[The emission of NO_x is based on the NO_x reported by Indaver: 1,8 g per ton waste.](#)
- Based on the results of a comparative LCA alone, it is not allowed to conclude that the environmental performance of one treatment is superior to another one. This is clearly stated in the ISO-guidelines.
[The conclusions are based on this LCA study and not on other studies.](#)
- Sensitivity analysis: only the aggregated results are shown. Better would be to only show graphs with the real LCA results with min and max and to explain. Because the shadow prices are completely dominated by greenhouse gases, of course you cannot see differences in the other impact categories. There may be significant differences however. Please change this presentation, at least if your intention is to inform us through the report.
[For the sensitivity analysis the same holds as for the LCA results themselves, that it is quite](#)

impossible to interpret them and to draw conclusions without aggregation. For almost every reader it will be difficult to interpret tables with real LCA-data. Besides, in most of the figures (24, 25 and 27), pre-treatment and transport, emissions, production and emissions have been distinguished.

- Annex with results showing min and max. The min and max from coal and petcoke results are not given separately. This is not very clear for the public. It is not clear which results are presented in the tables?

The minimum and maximum results related to emissions of petcoke and coal in cement kilns are listed separately in table 7 and 8 of Annex 5 LCA Results.

- A new draft final report should be made with the necessary corrections. This should be distributed to the expert panel and evaluated again, before the final report can be made. In the last meeting of the expert panel it was unanimously agreed that the final report would not be distributed once again, but that a reaction would be given on the comments and that both of them would be included in the report as an Annex.