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A Greenpeace brief on the report

The Behaviour of PVC in Landfill¹

published by the European Commission

"No total releases of phthalates from a PVC product under soil-buried and landfilled conditions has been reported, however in the long-term a total loss of all phthalates introduced in the MSW [municipal solid waste stream] and landfills through PVC products and the contamination of environmental media (soil, water, groundwater) via leachate cannot be excluded".

Key findings:

- Losses of phthalates from PVC materials are reported to be 30-35% of the total content under aerobic (oxygen present) conditions and 4-40% under methanogenic (methanogenic bacteria activity) conditions.
- A total loss of all phthalates from PVC products and the contamination of environmental media via leachate cannot be excluded.
- PVC materials are likely to contribute to gaseous emissions from landfills. Emissions were found to be carcinogenic in one out of four laboratory tests.
- Emissions resulting from the presence of PVC in landfills are likely to last longer than the guarantee of the technical barrier of the landfill.
- It is not possible to eliminate phthalates in leachates from landfills with current treatment methods.
- Technical solutions to treat or contain leachates indefinitely might be possible but would be very costly.
- It was not possible to quantify the releases of lead and cadmium, but they should not be neglected as a very slow process will also contribute to landfill emissions.
- PVC products will certainly contribute to the formation of dioxins and furans in landfill fires.
- Degradation of the PVC polymer chain itself was observed under landfill conditions.
- A series of additional aspects need to be investigated (e.g. additives such as bisphenol-A and chlorinated paraffins)

¹ ARGUS in association with University Rostock-Prof. Spillmann, Carl Bro a/s and Sigma Plan S.A.

The PVC industry has always maintained that PVC is completely stable and has no negative effects on landfills and they have commissioned their own studies to support this. In this report commissioned by the European Commission there is no support for their view. The report shows that there is no doubt that PVC contributes significantly to making landfills more dangerous to the environment, with problems ranging from the long-term leaching of additives to the degradation of the polymer itself.

Losses of additives

Due to restrictions in scope and time, the study only makes a more in-depth analysis of one group of the many hazardous additives used in PVC. A review of the behaviour of phthalates from PVC in landfills reveals that these pose a problem for the environment for a long time to come, at least longer than the guarantee of the technical barrier of the landfill.

Phthalates leach extensively from plastic. The loss of phthalates from PVC materials are reported to be 30-35% of the total content under aerobic (oxygen present) conditions and 4-40% under methanogenic (methanogenic bacteria activity) conditions. A total loss of all phthalates from PVC products and the contamination of environmental media via leachate cannot be excluded.

At present, there is no treatment method to eliminate phthalates in leachates from landfills. The authors argue that it might be able to develop such methods, but that they would be very costly.

Another worrying finding was that air emissions from degrading PVC plastic revealed a carcinogenic activity in one out of four tests, which could be caused by the presence by one of the main phthalates used to soften PVC (DEHP).

It was not possible to quantify the releases of lead and cadmium, but they should not be neglected, as a very slow process will also contribute to landfill emissions.

Dioxin formation from landfill

PVC contributes to the creation of persistent chlorinated compounds in landfills and even though it was outside the scope of the report, the authors nevertheless included the formation of dioxins and furans from landfill fires in the literature study. From this they concluded that: *“During the fires, the concentrations of PCDD/PCDF [dioxins/furans] in the air of the landfills were high”* and that *“Laboratory tests with different types of PVC products report formation of PCDD/PCDF in the level of microgram per kilo”*, and finally that *“PVC products disposed of in landfills will certainly contribute to the formation of PCDD/PCDF, but the quantitative contribution cannot be estimated”*.

From available statistics from Finland and Sweden it can be concluded that landfill fires are a common occurrence (around 50-60 annual fires per 100 landfills).

PVC degradation

The environmental poisons that have created most havoc in the environment are persistent chlorinated compounds (e.g. PCBs, CFCs, dioxins etc.). This is the reason that international treaties and national legislation target these types of compounds for phase out. PVC is in reality a persistent chlorinated compound, but the PVC industry's position is that the length of the polymer chains makes these compounds harmless because they cannot enter biological organisms. The PVC industry also holds the notion that PVC is a material that will never break down. However, this report indicates that there are conditions in landfills and **probably also elsewhere** in nature that can break up the polymer chain and thereby create chlorinated compounds that are more **readily absorbable for biological organisms**.

This could be a parallel to CFCs which were also considered harmless and non-degradable until it was found that the CFCs were degraded in the stratosphere where the chlorine atom was let loose to destroy the ozone layer.

Restrictions

The study highlights some of the important problems with PVC in landfills, but the authors admit freely that because of lack of data and restrictions on the scope of the study, they were not able to analyse all the potential problems. The PVC industry claims that the behaviour of PVC in landfills has been thoroughly studied, but the authors state: *"Because of the very limited number of reports concerning the behaviour of PVC in landfills, the literature study was extended"*.

The authors also had problems to obtain all the necessary facts: *"Due to the information policy of the part of the PVC producers, it was not possible to analyse in detail but a broad spectrum of additives contained in PVC-samples was discovered."*

The authors finish the report with a series of aspects that should be further investigated: Further investigations are needed into the degradation of the PVC polymer in landfills, the influence of different stabilisers and plasticisers on the attack of PVC in landfill, the identification of the carcinogenic effects of the gaseous emissions, the quantitative load of PVC additives in landfilled municipal solid waste, accumulated quantities of PVC and PVC additives in landfills and identification of all additives used in PVC products, including those not previously investigated, and their behaviour in landfills (e.g. bisphenol-A, chlorinated paraffins, organotins).