Environmental analysis of drinking water installation systems

The result speaks for plastic installations

ENVIRONMENT

1. INTRODUCTION

When conducting a complete environmental analysis of a product it is essential to consider all aspects of the products development from raw material sourcing through manufacture to the finished products ecological impact.
In the study "Comparative Ecological Analysis of Drinking Water Installation Systems" a detailed analysis of drinking water pipe installation systems was conducted at the Technical University, Berlin covering

- raw materials
- pipe / fitting production
- system components
- insulation and
- installation of the materials
- polypropylene (PP)
- vulcanised polyethylene (PEX)
- polybutene (PB)
- chlorinated polyvinylchloride (PVC-C)
- copper (Cu) and
- galvanised steel

In order to achieve an impartial and objective interpretation at this data the VENOB method of comparlsion development by the Technical University of Berlin was adopted. The analysis results evidence a wide range of emission values over the sample materials.

2. ECOLOGIACAL ANALYSIS-MODEL INSTALLATION

Table 1 shows the skeleton conditions according to DIN 1988 Part 3 for a standard drinking water installation. Table 2 lists the raw materials under review together with their connection techniques.

Table 1 · Calculation principles of the installation.

Drinking water installation acc. to DIN 1988 part 3
16 housing units
Central warm water supply
max loss in pressure at the floor 1800 mbar
Supply pressure 4 bar

Table 2 · Selected pipe materials of the drinking water installation

Pipe systems / Pipe material	Connection Technique
polypropylene (PP)	welding
polyethylene vulcanised (PE-X)	clamping
polybutene (PB)	welding
polyvinylchloride chlorinated (PVC-C)	bonding
copper	soldering
steel galvanized	screwing

3. METHOD OF COMPARATIVE ECOLOGICAL ANALYSIS

The procedures for conducting the ecological analysis are shown in table 3.

Table 3 · Method of an ecological analysis

1. Definition of the type of problem and skeleton conditions
2. Test reg. the functional equivalence
3. Analysis of the building element in test
4. Fixing of the system limits
5. Calculation of the energy consumption
6. Analysis of the emissions in air, water, and ground
7.Comparative result standardised examination (VENOB)
8. Exploration of the test result

4. MATERIAL DATA

4.1 Plastic pipe systems (PP, PE-X, PB, and PVC-C)

The basic data for the production of PP and PE granulates has been obtained from a study compiled by the Association of Plastics Manufacturers in Europe (APME) and has been adopted to meet the projects system limits.
The data for PB is based on own calculations provided by the relevant plastics manufacturers. The basic data for PVC production as a preliminary product of PVC-C, was obtained from a study conducted by the APME and was adopted to meet the projects system limits. The data for chlorination was obtained directly from the plastics manufacturers. The relevant data compiled for producing pipes and fittings was determined by own measurements conducted on the spot.

4.2 Copper pipe systems

The current recycling quota of 49% was taken into consideration for the field of copper production. The remaining 51% was provided by the copper mining and pyrililerous smelting sectors.
The copper content of the ore mined is a substantial guide to the quantity of ore that has to be mined and processed. The average copper content, of mined ore, was determined for these calculations at 1.2%. After processing the copper content increases to 26%.

4.3 Galvanised steel pipe system

The metal content of the oxide ore used in the production of galvanised pipe systems amounts to 60%. In steel production both the blast furnace process and the electro-smelting method were considered as scrap processing procedures. The recycling quota of 35% is proportioned blast furnace at 15% and electro-smelting furnace at 20%.

4.4 Connections

The connecting materials, supplementary materials, and connecting techniques required by the various systems were taken into consideration in calculating the overall data for the individual systems.

4.5 Pipe insulation

All drinking water installation systems are insulated with low-density polyethylene (PE-ID) pipe insulation.

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5. RESULT

The standardised results for pollution loads on air, water, and ground for the respective drinking water installation systems, based on a 16 family unit block of apartments, under the criteria acc. To DIN 1988 Part 3 are documented in the following diagrams. The data presented as plastic system “Min” and plastic system “Max” represent real drinking water systems.

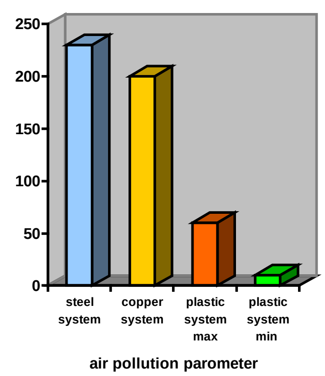

Diagram 4 · Standarized non-dimensial air pollution parameter of the systems

In diagram 4 the metallic systems of galvanised steel and copper represent one group with the two plastic system categories of “Min” and “Max” forming the limits of the second group. The steel and copper pipe systems show high absolute values in a large number of emissions.

In diagram 5, with regard to the pollution load on water, the metal pipe systems evidence considerable sulphate and fixed particle emissions in the upper omission range.

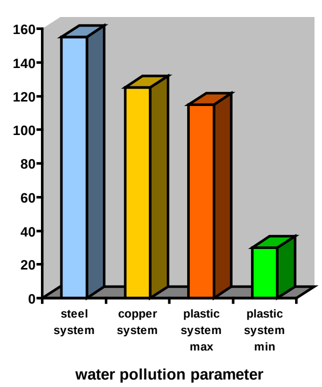

Diagram 5 · Stadarized non-dimensional water pollution parameter of the systems

In diagram 6 the ground pollution parameter indicate, in the case of metal systems, a high standardised value resulting from the relatively high quantity of electric energy consumed in their production, especially where there is a low copper content present in the cupriferous one.

In diagram 7, the metal systems, even considering the recycling quotas, evidence high energy levels for the production of their base material.

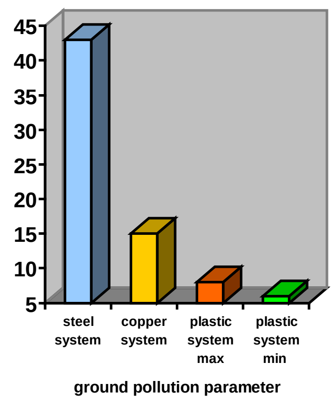

Diagram 6 · Standarized non-dimensional air pollution parameter of the systems

Due to their lower densities plastic systems are considered significantly lighter in weight. The steel system ranks at the top of the list of system weights.

Note of the Publisher*
In case of plastic systems there exists, within this group, considerable environmental differences.

a) The total energy consumption let PVC production, as preliminary product for PVC-C is considerably higher than that of polyalelins [polypropylene and polybutylene] even without including energy consumptions data for chlorination. Chlorinated plastics are problematic in view of their recycling and waste management – chlorine production is also very cost intensive.

b) Vulcanised polyethylene requires metallic clamping and is not considered as favourably as polypropylene and polybutylene for its energy balance, processability, recycling and waste disposal PVC-C is bonded.

c) In terms of recycling and waste management PVC-C and vulcanised polyethylene are considered the least satisfactory of the plastic materials. *

6. SUMMARY

In the ecological analysis of the six difference drinking water installation systems conducted under the VENOB method the results clearly more intensive

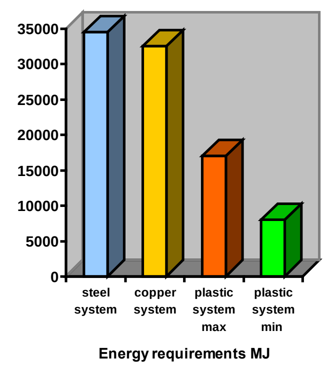

Diagram 7 · Energy requirements of the systems in megajoule

ecological pollution loads associated with the use of metal pipe systems. Differences can also be seen between the individual plastic pipe systems. The use of drinking water pipe systems manufactured from the plastics under review of PP, PE-X, PB and PVC-C represent a more ecologically beneficial solution than the use of metal systems. This statement pronounced a long time ago has now been confirmed by these relevant examinations. “But there are also differences between the individual plastic pipe systems in view of their energy balance processibility, recycling, and waste disposal; on the whole PP and PB present the most environmental beneficial alternative compared to metallic pipe systems.

7. LITERATURE

(l) Kauter H., Weinlein R. Jokel C.: Final report: Comparative analysis of drinking water systems, Technical University Berlin, Berlin, 12. 1994

8. SOURCES

SANITAR + HEIZUNGSTECHNIK, Journal for planning, calculation, and installation of sanitary, heating, and air conditioning plants, Edition 4, April 1995, Krammer Verlog Diisseldorf, Pages 113-116, 121-122 / Additional proper tests: M. Walfort Sensoric + Organoleptic, Dipllung U. Hofler, Quality management

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