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IRON AND MANGANESE SURVEY IN AQUIFERS SURROUNDING LANDFILLS IN WALLONIA (BELGIUM)

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BACKGROUNG

It is well known that leachates produced by water percolation through waste solid often contain high concentration of dissolved Fe and Mn. This is mainly due to the anoxic biodegradation of the waste. Ferric iron (Fe(III)) and Manganyl (Mn(IV)), present in the solid waste, are reduced by anaerobic bacteria during the process of hydrocarbons biodegradation. Ferrous iron (Fe2+) and reduced manganese (Mn2+) are much more soluble that their oxidised state and pass in solution.

Fe(III) and Mn(IV) also enter in the composition of aquifers matrix (sand, rocks). It constitutes a second reserve of electrons acceptors for anaerobic biodegradation in aquifer environment. If leakages occur under landfill with leachates reaching water table, Fe and Mn concentration may be less affected than other constituents by the induced dilution in subsoil water.

As a result, Fe and Mn concentrations in aquifer could be considered as potential "markers" of landfill impact on surrounding subsoil water.

On the other hand, Fe and Mn are not listed as "to be controlled parameters" in aquifer above landfills in Wallonia. Neither "sectoral conditions" nor landfill exploitation licences include these two parameters. This lack is probably due to the combination of the following factors:

- Fe and Mn are "non hazardous" constituents;
- Fe and Mn are present in relatively large amount in natural groundwater systems.

Environmental survey of every municipal solid waste ("MSW") landfills in Wallonia is achieved by ISSeP for ten years. Within this framework, Fe-Mn concentrations in groundwater around each landfill have been, at least once, measured. For three particular landfills, those analyses lead to interesting results that are presented in this paper.

OBJECTIVE AND METHODOLOGY

The main objective of present study is to draw the attention of local authorities on Fe-Mn concentrations in aquifer around waste landfills. Several possible interpretations of the measured values are developed. Further future investigations, including systematic integration of Fe and Mn in surveying networks, are proposed.

The work is based on two type of sample: leachates samples and subsoil water sample. Fe and Mn are first analysed directly in leachates at the entrance of treatment plants. On each studied landfill, Fe and Mn groundwater concentrations are measured in one upstream piezometer and in two or three downstream piezometers. Expected regular concentrations in each regional aquifer are collected the literature.

Concentrations in leachates give an idea of its polluting load. The comparison between downstream and upstream values gives an idea of potential impact of landfill on groundwater quality.

Comparing downstream concentrations with regular values known in the regional aquifer allows evaluating the possible natural variation of water composition due to lithological heterogeneity.

In a first evaluation, three particular landfills have been studied: Tenneville, Mont-St-Guibert and Happe-Chapois. They have been selected with the aim of considering:

- Various exploitation methods (Tumulus building, ancient quarry filling, valley filling);
- Various aquifer conditions (sand, sand-stones, siltstones).

Each of them can be considered as typical "MSW" landfill, having a long history, which induces that some of their filling cells are not equipped with adequate bottom liners.

RESULTS AND DISCUSSION

The landfill of Mont-Saint-Guibert is an ancient sand (Tertiary) quarry, progressively filled with municipal solid waste. Natural groundwater table in tertiary sand aquifer corresponds to the bottom-level of the quarry. Both Teneville ("tumulus type") and Happe-Chapois ("valley-filling type") are localised on siltstone and shale bedrock. Above these landfills, hypodermic underground water stream occurs in the upper weathered ground layer.

Fe and Mn show high concentrations in the three leachates (Fe: 1.500 to 3.000 µg/l ; Mn : 370 to 4.200 µg/l). Measured Fe-Mn concentrations range from less than detection limit value upstream to more than 1.000 µg/l downstream. Mean Fe-Mn concentrations downstream Mont-Saint-Guibert are from 10 to 50 times as high as regular regional concentrations in Tertiary aquifer. Downstream Tenneville, they are from 10 to 25 times as high as regular concentrations in bedrock regional aquifer. Finally, they are from 150 to 830 times as high as the normal concentration in bedrock water downstream Happe-Chapois.

CONCLUSIONS AND PERSPECTIVES

A lot of technical problems incite to examine cautiously the result of this investigation:

- Too little measures in time (due to the lack of legal obligation);
- Too little measures in space (lack of piezometer at larger distance from landfill);
- Sampling method (need of systematic "on site filtering" to measure dissolved ions only).

For the same reason, the work presented here has to be considered as the start of a larger study.

Further investigations, including more regular sampling with harmonized method and on extended piezometer networks, should be undertaken in the future. Such investigations require political decisions and administrative follow-up. It also needs support of and collaboration with the scientific community, of course locally but even internationally.