IDENTIFICATION AND EVALUATION OF SOURCES OF POLLUTION IMPACT ON REPRESENTATIVE AQUIFERS IN THE INDUSTRIAL AREA ORADEA AND SURFACE WATER- SUDRIUGIU BEIUS AREA

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Abstract:
In this paper, with the above title, we intend to address the following issues:

- *Identifying possible sources of pollution of the aquifers in the area of interest: the groundwater in the alluvial cone of Crisul Repede, referring specifically to the industrial area and the city of Oradea*
- *Simulation variants and interpretation of the results of the simulations from the studied area;*
- *Assessing the impact of these sources of pollution on the groundwater regime, from the mentioned industrial area.*
- *Analysis and monitored data interpretation in order to assess correctly the chemical status of groundwater and surface water in this area*
- *Motions and control measures for the water corp ROCE01 – the*
- *Industrial area of Oradea, proposals and control*

The paper ends with a separate chapter titled "Attachments" "Bibliography".

Key words: pollution, aquifers; underground water; waste; surface water; simulation.

INTRODUCTION

1.The alluvial cone of Crisul Repede representing a hydro-geological overview is the most important, hydro-structure in the North – Western part of the country. The alluvial cone is well developed downstream of Oradea, on both sides of Crisul Repede with a large extension to Hungary.
The drilling executed in this area shows that the alluvial cone consists of: sand, gravel and rocks with intercalations of clay.
The maximum development of the depth of the cone alluvial are registered in the border area with Hungary and Bors area where alluvial cone depth is 19-20 meters, in contrast, with northern and southern extremities were reduced to a thickness of 5 m.
The aquifer present in the area is continuous and uniform, except for a lens of clay, small stretched on about 3.5 m, located on the right side of P8 drilling (former Alumina).The type of aquifer has one free level, supplied mainly by runoff and spills on the slopes of the piedmont of Oradea (in East). The main watercourse that crosses the aquifer is Crisul Repede river, namely: water supply channels for fishing, from the area (which have a low hydrological importance). Depending on the levels recorded in Crisul Repede, it takes place: a phreatic supplying at high and medium waters, respectively: A drainage (collection and exhausting) at low levels.
The underground flow has a general flow direction from east to west, hydraulic gradients a range between the values from 1.4 to 3.5 ‰.

MATERIAL AND METHODS

2. *Identifying possible sources of pollution* in industrial area of the municipality of Oradea and the Beius – Sudrigiu area.

In the activity of inventory of the possible sources of pollution of the alluvial cone Crisul Repede, the industrial area of Oradea, I had in mind:

1. Locations with economic units that can be real sources and virtual sources of pollution of groundwater in the studied area.
2. The evaluation of groundwater quality based on data monitored (and controlled surveyed) on targets of the National hydro-geological network (the last period of time) that is in the last 10 years.
3. Monitoring program (based on electronic surveillance equipment and systematic measurements, carried out in time, environmental factors), and ecological status of surface water quality in the area Beius - Sudrigiu.
4. Specifically, in this study, we took into account of the 9 (nine) observation points and three (three) sectors monitored, namely: pollution control stations and observation wells as appropriate), and only those located on the left side and right Crisul Repede and the Sector of Santaul Mic
5. Among the pollution control stations and observation wells analyzed, remind stations:
   - P6 (from SC "Summary" SA)
   - P8 (from SC Cemtrade SA, the former factory "Alumina" Oradea)
   - P13-F6 (SC "Orser SA, the former" SERE "- Oradea)
   - P14 - F7 (Diocese Bihar)
   - P15 - F1 (Santaul Mic with Slag and ashes dump from CET1 - Oradea).

As possible sources of pollution in the industrial area in the West of Oradea, reminds:

- Wastewater Treatment Plant of the municipality of Oradea
- SC Cemtrade SA "(formerly" Alumina ")
- CET 1 (Electrocentrale Oradea)
- SC Synthesis SA Oradea

The pollution of surface water (rivers particularly Crisul Pietros and Crisul Negru) Sudrigiu Beius area is due to wastewater (altered degraded or polluted), with a large cargo hold, resulting in:

- Technological processes of manufacture of fermented products (see: Alcohol Factory - Sudrigiu) or
- From industrial complexes and individual livestock farms (or another):
- Waste water discharged from human settlements, the area Beius - Sudrigiu (water with high organic load).

3. *The valuation of the impact* of these pollution sources on groundwater of these areas. In assessing the impact of these sources of pollution in two areas: West Industrial Area of Oradea and the Beius – Sudrigiu area, I summarized these issues / problems:

- Sources of pollution and pollutant elements (pollutants for the two areas);
- Assessment of chemical status of groundwater and surface water based on threshold values (TV) and the natural background values (NBL).
- Analysis and interpretation of monitoring data, on the main indicators (NH4, NO4, PO4, SO4 ....) and the threshold value (TV) for water body ROCR01 and observation wells referred to above.

a) *The impact of pollution sources* on groundwater from the industrial area of Oradea. For the source of pollution: Slag and ash from CET1 - Oradea pollution has a continuous type. In windy conditions, the slag and ash dumps from CET1, pollutes large surfaces

with the new red dust resulting from the slag stored here. Comparing some physical-chemical indicators and threshold values there are found large differences, such as:

- For phosphate (PO 4), we THRESHOLD VALUE: <= 0.5 mg / l, in reality (on land) were found 1.29 mg / l in 2009 and
- At the sulfates indicator (SO4), the threshold value: <= 250mg / l, and pollution control station P15-F1 (located at Santaul Mic - mound of clay) were found / determined in 2008, the amount of 668 5 mg / l.
- At "Sinteza" SA / Station P6, the concentrations were determined by the nature of inorganic industrial waste, metals, metalloids, acids, salts, alkalis, cyanides.

Also, from the Water Company, Oradea, we have specific pollution that is composted sludge resulting from sewage treatment station, from the Municipality of Oradea.

In assessing the chemical status of groundwater in the area of interest I had in mind the following issues:

1. Setting threshold values (TV = "Tresholds Value"), based on the

values (levels) the natural level (NBL) and comparing them with a reference MAC value (maximum permissible concentrations), and in addition, the application of existing legislation, namely:

a. Law 458/2002, on water quality and
b. Law 311/2004, Law 458/2002 which completes.

2. Analysis and interpretation of monitoring data on key indicators and threshold values (TV), for the body of water wells and the observation on ROCR01 mentioned above (see: Tables No. 1, 2 and 3 from Chapter: Appendix).

b) *The assessment of sources of pollution impact* on surface waters Beius - Sudrigiu area

Mainly, the pollution of surface waters from the area Beius - Sudrigiu, refers specifically to: Crisul Pietros (near the villages Draganesti and Sudrigiu), respectively: Crisul Negru (downstream Sudrigiu and upstream Beius, and the water - Nimaresti - Section Beius) is due to wastewater discharged from human settlements, crossed by the waters The area mentioned above, as well as: waste water due to manufacturing processes of fermentation products (from alcohol and beer factory - Sudrigiu). Industrial waste waters have a high toxicity, and waste water discharged from a large human settlements have organic charge.Thus, wastes discharged from the manufacturing of beer, containing: carbohydrates (sugars - about 55%), protein (about 25%) and the remaining cellulose, fat. Chemical properties of waste water (water with impurities, discharged from economic units, institutions...), are related to: DO (dissolved oxygen) CBO5 (biochemical oxygen consumption 5 days), the water pH and the dourness of natural water.

The classification of water quality in relation to general indicators (physical-chemical indicators: pH, DO, BOD5, Nutrients - NH4, NO2, NO3, PO4 ...) and indicators: 0 priority substances and metal compounds: Arsenic and compounds Cadmin and compounds, Mercury compounds for the water course ....): Crisul Negru, Section I. Capture area Beius respectively the water course: Nimaiesti, Beius section, we used a part of database monitoring program of the Department of Water - Cris Oradea, to which we bring sincere thanks on this occasion. (See Tables 7 and 8 of the Annex).

4. Simulations variants for the impact of pollution sources and the analyzed area

The simulation and evaluation of the pollution sources impact to the underground water regime from the industrialized area of Oradea, has been done using the computer software –

ASWIN ("Aquifer Simulation for Windows") consisting in a professional graphical interface, a model of flowing in finite differences and a model of transport using the so called method of "Random Walk".

Using the Flowing Model based on the input data and the limit conditions we may obtain the piezometryc heights and the speed field. The speed fields, together with the time and transport parameters are used in the model of transport.

The simulations variant, for the impact of pollution sources, from the studied area, have in consideration: instant injection pollution sources (for the pollution source of SC "Sinteza" SA) and with continuous injection (for the pollution source – sterile waste of CET1 – Oradea), and précising the time and transport parameters of:

- Longitudinal and transversal dispersion
- Existence or non existence of diffusion
- Total time of the simulation and the steps of time used

The link between the two models (flowing and transport models) may be seen below:

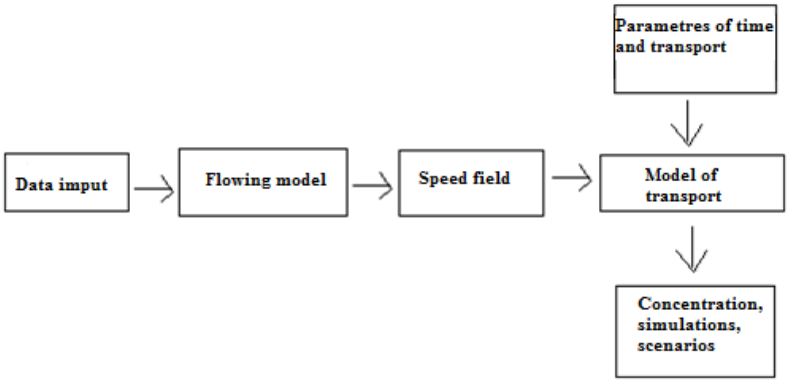

Fig 1: The link between the Flowing Model and the Transport Model

RESULTS AND DISCUSSION

Concretely, we will present below 2 of the simulation variants:

Variant 1:

- Pollution source: SC SINTEZA SA – Oradea (description)
- Instant injection, from the pollution source „SINTEZA" – Oradea
- Type: - phreatic flowing model
- Effective porosity: 0,2
- Longitudinal Dispersion considered: 120 and 150m
- Transversal Dispersion considered: 10 and 15 m
- Late Coefficient: 1
- Molecular diffusion coefficient: 0
- Total time of the simulation: 5, 10 years
- Time steps in simulation: 10, 20 days

Variant 2:

- Pollution source: Sterile waste pollution source of "CET 1" - Oradea
- Instant injection, from the steril waste pollution source "CET 1"– Oradea
- Type: - phreatic flowing model
- Effective porosity: 0,2

- Longitudinal Dispersion considered: 120 and 150m
- Transversal Dispersion considered: 10 and 15 m
- Late Coefficient: 1
- Molecular diffusion coefficient: 0
- Total time of the simulation: 5, 10 and 15 years
- Time steps in simulation: 10, 20 days

The interpretation of the simulation results

According to the versions of simulation presented above, instant injection pollution simulations in different locations: SC Sinteza SA – Oradea; continuous injection for the sterile waste of CET1- Oradea, we may interpret:

- The flowing model is a phreatic one
- The main process of transport: convection which doesn't not sustain very much the simulations because of the small values of gradients flowing of the underground waters.
- The main flowing directions of the underground current is from East to Vest, to Hungary.

This remark, makes that the study of the pollution transport in this area (alluvial cone of Crisul Repede, to be an actual preoccupation:

- The omission of the diffusion phenomena of pollution transport (from simulations) does not imply essential modifications of concentration.
- The type of instant injections from the simulations, implies an accidental type of pollution which might happen especially in the industrial area of Oradea – for SC Sinteza.
- For the pollution source: sterile waste of CET1 Oradea, we may consider a continuously injection pollution because of the sterile waste existence

CONCLUSIONS

Nowadays, the theoretical and practical acknowledgement of the ground and underground pollution phenomena is very important, because of the sustainable development politics.
The necessity of understanding, knowledge and applying the techniques of protecting the waters, derives from a very well known and acute phenomena: the pollution.
The pollution of waters, mainly the underground ones, represents an interdisciplinary and complex phenomenon to which contribute a great number of sciences / disciplines, reunited together under the denomination of "environmental engineering".
In this context, we proposed to discuss this theme:
Identification and Evaluation of the Impact of some Pollution on the Aquifers of the Industrial Area of Oradea"
In treating this theme, we considered:

- Identifying some possible significant pollution sources to:
  - The underground waters of the industrial area of Oradea
  - Ground waters of Beius-Sudrigiu area.
- Evaluating the impact of those pollution sources to aquifers
- Presenting simulations versions in this case and interpreting their results

- Control measures and proposals for the Water Corp ROCR01, proposals conform to the 96/61/EC Directive, regarding the integrated preventing and controlling pollution.
- Regarding the control measures and proposals for the pollution of underground waters – for ROCR01 Water Corp, we may affirm that:
    - Prevention the deterioration of the underground waters quality must be realized mainly by implementing the 91/676/EEC, regarding nitrates and the 91/271/EEC Directive, regarding the urbane residual water treatments, modified by the 98/15/CE Directive;
    - Elimination the presence of dangerous substances of ground waters will be realized by the measures asked by the following European Directives:
        - Council Directive 92/43/EEC , regarding conservation of natural habitats;
        - Council Directive 96/61/EC, concerning integrated pollution prevention and control
    - Other measures:
        - The control of the flows from the canalization system or septic tanks that are incorrect maintained;
        - The control of residual waters, diverted in the ground;
        - The control of the ground (surface) infiltration waters
        - Industrial waste water pre – treatment and treatment as a result of the industrial activities.

REFERENCES:

1) Carabet, A., 1999, “Protectia resurselor de apa subterana”, Editura Mirton, Timisoara
2) Dimache, Al. and M. Manescu, 2002, “Poluarea apelor subterane – studii de caz”, Editura Orizonturi Universitare, Timisoara
3) Turcan, R., 2005, “Metode matematice de simulare a impactului amenajarilor si surselor de poluare asupra regimului apelor subterane. Studii de caz pentru spatiul din judetul Bihor”. Teza de doctorat – Universitatea Politehnica din Timisoara
4) Turcan, R., 2005, “Miscarea fluideor prin medii poroase”, Editura DigitalData, Cluj Napoca.
5) Water Framework Directive 2000/60/EC(WFD)
6) Underground Water Directive 118/2006/EC
7) Law no. 311/2004 in order to complete and modify the Law NO. 458/2002, regarding the drinkable water.
8) Council Directive 96/61/EC, concerning integrated pollution prevention and control.
9) Government Decision – GD no. 930/2005 regarding the issuing and maintaining the hidrogeological and sanitary protection areas.
10) Environment Ministry Order no. 137/2009 regarding the approval of the threesholds for the underground water corps from Romania.