Polluants transport simulation in aquifers layer, provided from infiltration of waste water coming from pig's farms

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Abstract: - These papers present, the aspect of the environment pollution caused by the waste water coming from the pig's farms from Romania.The study case presents the estimation of the affected areas by sulphates pollution and the concentration of this from underground water in the Berecsau Mare village. Also present, some technological scheme for treatment of waste water before the waste water is evacuated in rivers..

Key-Words: - groundwater, flow, catchment, water plant, calibration

1 Introduction

The effectives of pigs bred in Romania touch the maximum level in 1989, where it was bred 14,351,000 pigs. In that period in Romania it were 300 pig's farms in industrial system with a total effective 10,351,000 pigs and in individual farms bred 4,000,000 pigs.

In Timis County, the pigs effectives bred in industrial system registered in period 1986-1989 it was 1,463,000 pigs, the majority effectives it was hold by COMTIM (SMIETFIELD).

The daily quantity of dejections evacuate from a pig is appreciate at 6 % of alive animals weight and

the annual quantity of dejections produce by a pig is appreciate at 6.5 m3.

The farms which have the principal occupation fattening and breeding pigs, evacuate the dejection with spurt water under pressure (2…4 l/m2 floor or 15…19 l/pig).

The pollution produce by the residues from pigs farms its feel in atmosphere, underground water, in surface water and in soil. The smells are produce by anaerobe decompose of residues.

The pathogen agents can be transmitted from animals to people from atmosphere. Because of high level of phosphor, potassium and azoth from waste water which was evacuated in surface water will appear the eutrophication phenomena.

The waste water contains pathogen agents which can determinate human diseases.

Through infiltration of waste water in underground are polluted the aquifer stratum and also the catchments of water.

Like measurement for environment protection in period 1980-2000, in Romania was designed and executed 100 arrangements for waste water distribution on farming field (62,000 ha).

In Timis county it was executed 12 arrangements with a total surfaces 5,200 ha.

The waste water evacuated from pig's farms it was passed through a waste water treatment plant with a mechanical step, equipped with, grates settling tank and after it was passed in a storage basin. The clarifying water was pumped in a sink pipes network and with the irrigation equipment it was distributed on an agricultural field. The distribution methods used were, the sprinkling irrigation, only when the dilution of dejections were 1:5 until 1:8, or, through ground flow, if the dejections were diluted 1:3 with conventional pure water. Through, distribution of waste water on agricultural field it was trying to avoid the pollution of rivers and also was wished that, the agricultural plants to use a big quantity of azoth, phosphor, and potassium

In some conditions, the soil, can be considerate a step of biological treatment. When the soil is used like purification system the vegetations have an important role, because will use the nutritive elements from this waste water.

Evacuation of waste water with an insufficient treatment it determinates the pollution of surface water and underground water near pig's farms.

In Timis County the distribution arrangements which worked until liquidation, were the arrangements from Berecsau Mare Grabati, which belonged to COMTIM [4].

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Infiltrations effect of the waste water in underground water and also, in which way was affected the underground water catchments it was studied on 50 000 ha area, situate in south-west of Timisoara city (figure1).

From geomorphologic point of view the studied zone belong to West Plain which is part of Panonic Plain.

The general slope of field is 0.4 ‰ in NE-SV direction.

From geological point of view in the studied zone it was meet fluvio-lakeage deposit and alluvium-proluvial deposit. These deposits were composed with clay-sandy dust or sand horizons (dusty sand or clay sand).

The principal river from studied zone is channel Bega Veche.

The phreatic water-bearing stratum is with free level and has the hydraulic gradient 0.3 ‰. The hydrostatic level is at 1.84 m mean depth in north part and 3.2 m in south part of studied zone.

Because the hydraulic slope is small, the ground water almost stagnates.

In the superior part of water-bearing stratum is situate a seasonal water-bearing with free level, which is at 4-6 m in north part and 2-4 m in south part of studied zone.

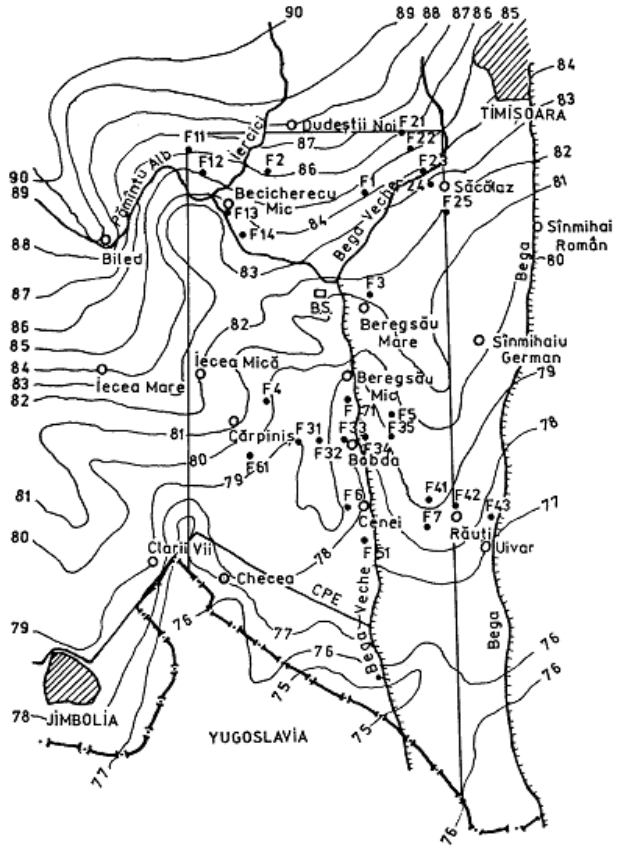

Fig. 1. Studied zone.

2 Problem Formulation

For impermeabilization of storage basin is used a polyethylene leaf with the thickness 0.3 mm, which is fixed on bed with an earth layer (0.25 m thickness) and on taluses with concrete slabs.This impermeabilisation is not a good solution because will not assure a perfect impermeability and from storage basin will appear infiltrations of waste water which will pollute the aquifer stratums. The quantity of infiltrate water from storage basin is 1.7 l/s. The infiltrate waste water in phreatic stratum will have the following average quantities of pollutants: 8.7 t/year chlorides, 13.9 t/year sulphates, 22 t/year sodium, 5.3 kg/year phenol and 53 kg/year total iron. Other quantities of pollutants will be provided from water, which was distributed on agriculture field: 55.1 t/year chloride, 85.5 t/year sulphates and 128.9 t/year sodium.

The quantity of water catch from phreatic stratum through domestic wells is between 0.6 and 2 l/s.

The water from these wells is not potable and will be use only for irrigation and for animals[3].

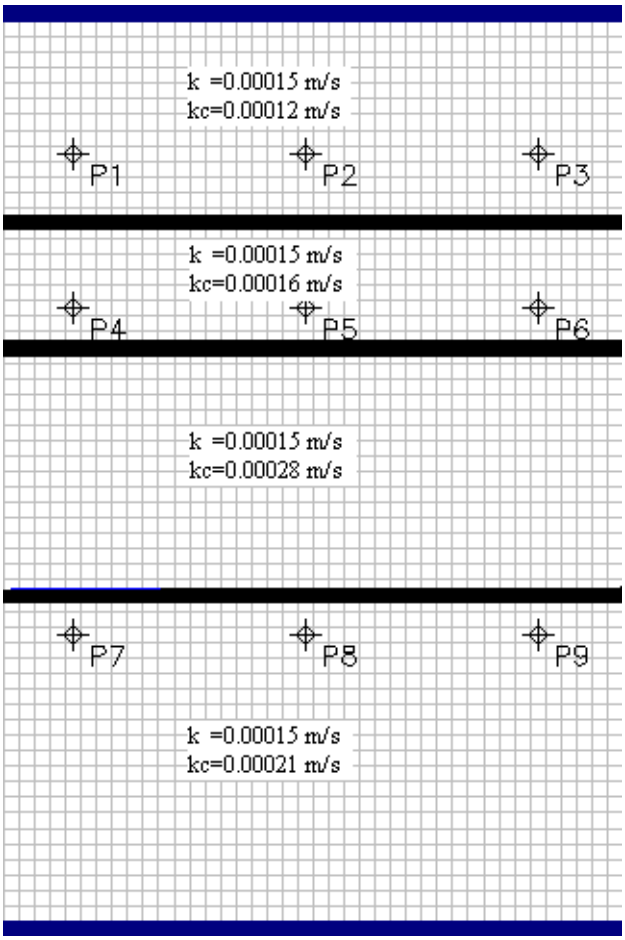

Fig. 2. The permeability coefficient before calibration (k) and after calibration (kc).

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3 Problem Solution

The program used to simulate the pollutants transport is ASM (Aquifer Simulation Model) [1]. The studied domein with a total area with 2,400 m2 was divided in rectangles (40 on the horizontal direction and 60 on the vertical direction) with the dimensions 100 m x 100 m.

Before, to simulate the pollutants transport was calibrage the model. The calibration consist in, established the piezometric elevations in wells and also to verify the permeability coefficient value [2].

The initial values for permeability coefficient (k) and after calibration (kc) are presented in fig. 2, and in fig. 3 are presented the piezometric elevations (a before calibration and b after calibration).

The porosity coefficient in the studied domein has the value 0.32. The ground elevation is between 82.40-83.00 m in top part of domein and between 79.60-80.00 in bottom part of the domain.The impermeability stratum is at 4.5 m deep from ground surface. The thickness of phreatic stratum is between 1.0 - 1.6 in top part of domain and between 2.0 - 2.4 in bottom part of domain.

The pollution of phreatic stratum is analyzed from sulphates point of view.

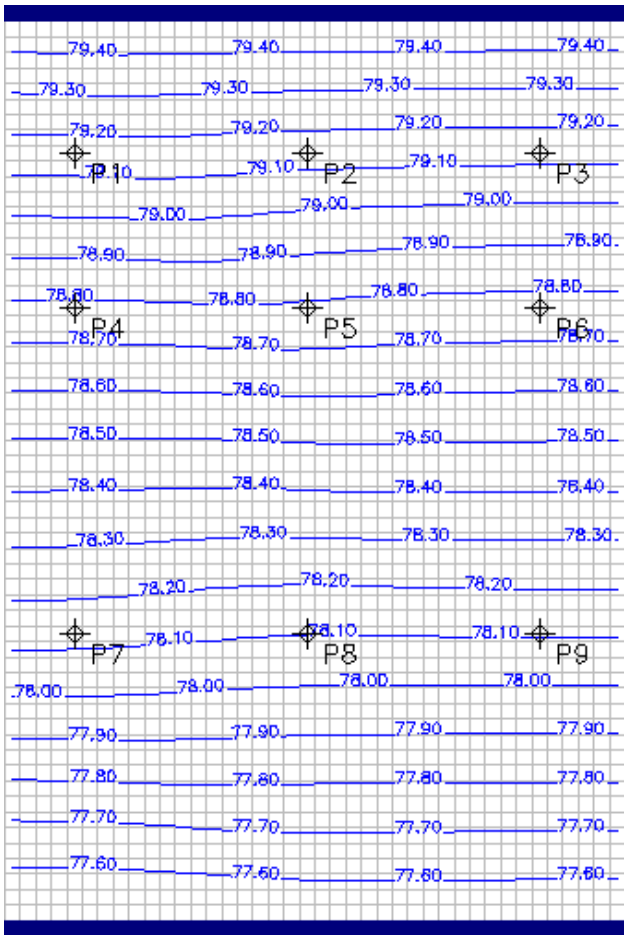

Fig. 3.a The piezometric level before calibration.

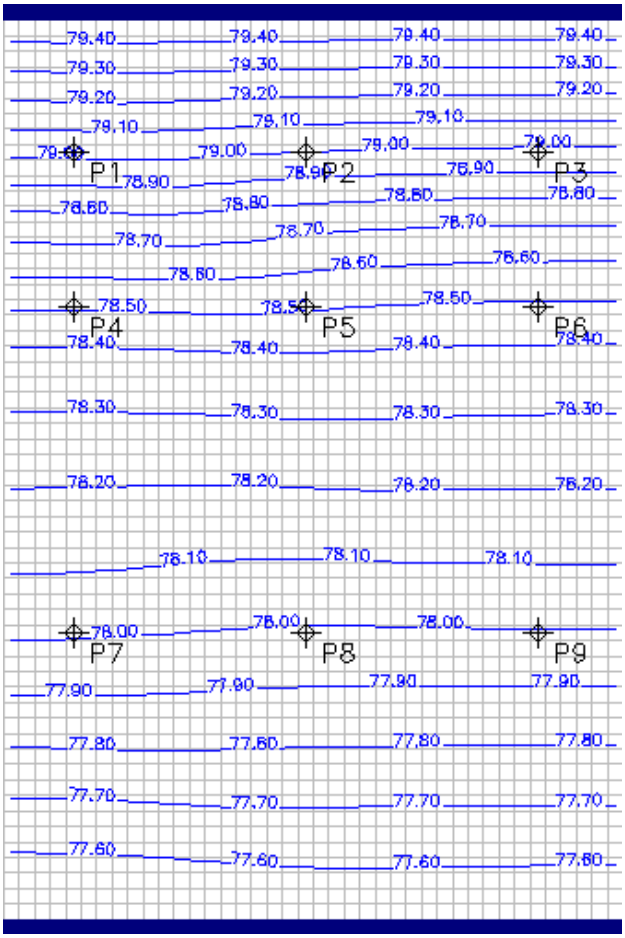

Fig. 3.b The piezometric level after calibration.

The infiltration and the transport periods of the pollutants were 15 years (the period how much worked Berecsau arrangement). To simulate this situation it was run the calculus program in permanent injection variant.

The sulphate, in the end of 15 years, was dispersed on a 40 ha. If the limit concentration of sulphates is 250 mg/ l (law 458/2002) than, those areas which passed the limit, are 4 ha.

The evolution of pollution plum in the follwing 50 years, after the polluation sourse was closed, it was simulated with a program in the instanouse injection.

The initial concentration it was considerated after 15 years of infiltration from phreatic stratum it was observed in 3 observer wells.

In fig. 4 is presented the diference between calculate piezometric levels and piezometric levels resulted after calibration.

The maximum concentration of sulphates from phreatic stratum, measured in observer wells (fig. 5) it was 352 mg/l.

The environmental protection around pig's farm can be realized through waste water treatment plants equipped with biological step.

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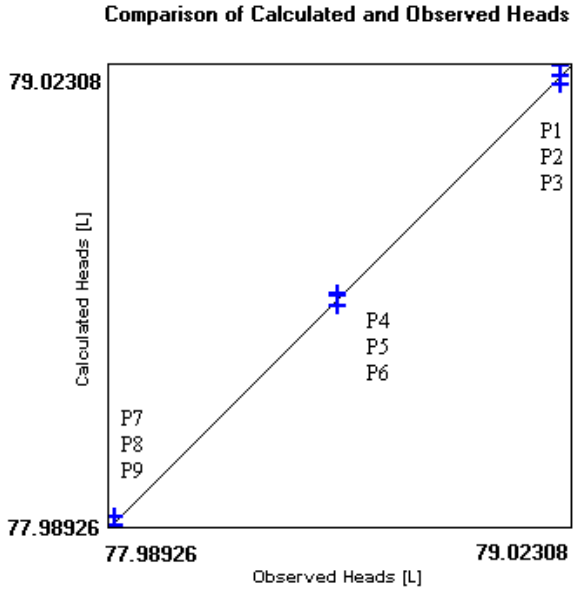

Fig. 4. Comparison of calculated and observed heads.

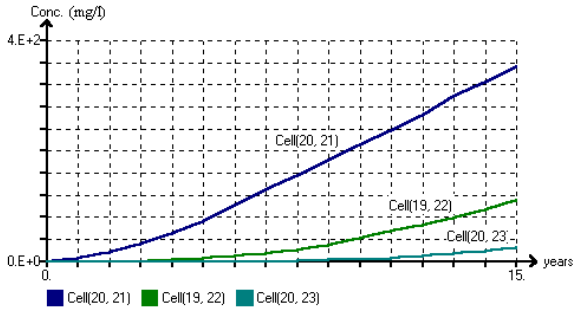

Fig. 5.a The maximum concentration of sulphates from phreatic stratum, measured in observer wells (Permanent injection 15 years)

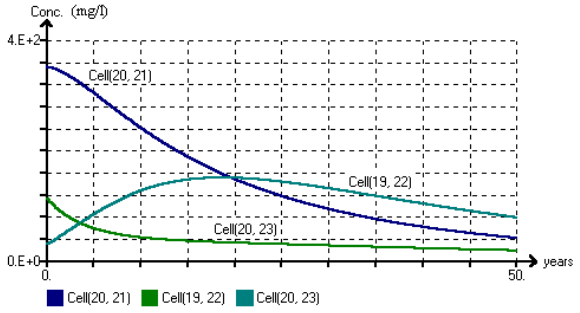

Fig. 5.b The maximum concentration of sulphates from phreatic stratum, measured in observer wells (Instanenous injection 50 years)

4 Conclusion

Because of the small velocity of the underground water, will appear small surfaces, affected by sodium pollution. The polluted phenomenon of the underground water will remain for a long time, even if the source of pollution (Berecsau Mare) is closed.

The environmental protection around pig's farm can be realized through waste water treatment plants equipped with biological step.

The actual technology for treatment of waste water, equip only with grates and settling tanks can be improve with biological ponds after secondary settling tanks.

The biological ponds can be considerate an advanced step of treatment and can be equip wit aeration system.

For depolluation of underground water are used reactors with ions exchange which use synthetic resin.

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