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THE REALISATION OF A DRINKING WATER IMPROVEMENT PROJECT BY THE STUDENT SCIENTIFIC “ECO-ENGINEER CLUB”

Together with the development of a system of economic instruments of environmental protection and the progress in sanitary engineering technology, the toxicity of the point sources of pollution is diminishing in Poland. Unfortunately, the influence of the non-point sources of pollution on the state of the natural environment has been increasing. The quality of drinking water is of vital importance to the state of public health. Compared with the Western European countries, the Polish people display a shorter life expectancy, greater infant mortality rate and higher death rate due to civilization diseases such as diseases of the cardiovascular system and cancer. Unfortunately, the public water supplies deliver water of unsafe and bad quality in 26% of cases. Thus, several million people in Poland constantly drink water unfit for use.

Agriculture has the most significant influence on the worsening of underground water quality. Use of fertilizers, manure and crop protection chemicals has led to underground water pollution. Engine fuels and lubricates, petroleum contamination and industrial waste from industrial air and water pollution are all threats of water contamination. During the period of forty years after the second world war there was an increase in of fertilizer use (by more than a hundred times) and in pesticide use (by more than thirty times). The application of both in agriculture has led to a double negative result, mainly: health problems and soil exhaustion. It was proved that the death rate due to cancer and poisonings among rural men is 10% higher in the country than in the towns. Consumption of water which is contaminated with a great

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number of biogenic compounds, can bring about such health problems as: skin, eyes, digestive system, respiratory problems and osseous systems diseases. Especially water with high a nitrates content can cause methemoglobinemia and also activate hypertension.

Underground waters in the Opole region are being researched within the monitoring system. These waters are differently isolated from the ground surface. It has been observed that even deep waters are endangered by pollution, which causes their quality degradation. Water quality is characterised by a high concentration of nitrates and nitrites and occasionally by a fluorides and nickel content. Furthermore, a high concentration of sulphates, calcium, phosphates and hydrogen carbonates has been found.

The financial outlay on water protection in the Opole region has been diminishing. In 1990 it constituted 52.4% and in 1995 only 12.7% of the general sum for the environment protection in this region. Water quality improvement cannot be achieved without the engagement of local citizens and without a radical improvement in the state of ecological awareness.

The purpose of the Club of Eco-engineers is to improve the ecological awareness of students and to organize people locally. Through such opportunities like the July, 1994–1998, Eco-camps held in Turawa, the university-based scientific education is being transformed into a practical project critical to the research, monitoring and planning of the environmental quality in the Opole region.

The aim of the project presented was an improvement in drinking water quality in the wells of Rzedow village in the Turawa commune in the Opole region. Rzedow village has 308 inhabitants and its area comprises 10.45 square kilometres, 35% of which is grassland. The cropland is composed of V and VI soil categories. The village has not got any water main and sewer systems, therefore the only sources of the local water supply are the individual water wells.

Within the preparatory work of the hydrological documentation of underground water resources in category B, a test well of a depth of 51 meters, has been made. The quaternary layer in the region of research has a thickness of 33 meters and has been formed as fine-grained sands, medium grained sands, sands with gravel and gravels. One water-bearing level has been ascertained at a depth of 0.85 m in the quaternary forms. The filtration coefficient calculated on the basis of test pumping is 0.4001 m/h. Water from the test well is undrinkable, because it does not fulfil the standards of the Ministry of Health and Social Care regulations from 4.05.1990 and could only be used for consumption after its conditioning, deironing and demanganization.

A consumer, when drinking water, relies on his subjective taste and feeling in evaluating the water quality. The majority of Rzedow residents when asked to evaluate water quality, claimed they drink water of high quality. However, it is known that the lack of negative organoleptic features does not guarantee that water is healthy and fit for use. That is why the establishing of the basic parameters of water sources, of water from individual wells, has been carried out within this research. Such parameters as colour, smell, turbidity, dissolved oxygen, pH, phosphates, ammonia nitrogen, nitrate nitrogen, and nitrite nitrogen have been determined.

Interpretation of the water quality research results is very difficult, because the data obtained are very unstable. The results differ due to the seasons, the soil profile, the distance between the well and the source of pollution, technical conditions of the well, periodic field fertilization and the way water is being delivered to houses.

The presence of nitrates are often treated as indicators of underground water pollution. Denitrification usually proceeds in deep waters, where there are almost anaerobic conditions and there is acidic reaction. Thus, there is a high concentration of ammonia in such waters and other parameters remain uninvestigated (with the exception of iron). Unfortunately, in the water researched, ammonia is accompanied by a large amount of nitrites and nitrates, a significant plant smell and very intensive colour. It would suggest ammonia coming from organic sources, wastes or domestic and farm wastes.

The percentage share of ammonia in the water researched is the lowest compared to other forms of nitrogen and comprises 16% in summer, 4% in winter, 8% in spring, but in summer most of the wells exceed the ammonia standards for drinking water.

The design of this project is based on the US EPA (environmental protection agency) guidelines for regional water protection and management. I studied that material during the Summer of 1993 on a professional training program in the USA. The project was sponsored by the Rockefeller Brothers Fund and organized by the Local Democracy in Poland Office at Rutgers University in New Jersey (in cooperation with the Foundation in Support of Local Democracy in Poland).

The project methodology is as follows:

1. Defining the area of investigation (the Malapanew River Basin). Establishing contacts with persons critical to the project realization (e.g. the local environmental commission members) through letters, meetings, invitations to talk to the group on issues of environmental protection.

The research done qualified the Rzedow village water to the category of highly polluted. From the physical-chemical analyses of the water we

can conclude that drinking water of Rzedow village always contains great amounts of nitrate nitrogen. A high concentration of phosphates is continuously present as well. Water coming from fifteen researched wells is unfit for use. The most important reason for the more than average content of these nitrogen and phosphor compounds is the bad state of the individual sewage system and agricultural use of wastes.

2. Identification and localization of pollution sources in the Malapanew River Basin. This information usually exists for the point-source pollution, but rarely for the non-point sources, notably pollution originating from agricultural sources and residential housing, tourism and business. Thus, the precise location and identification of the non-point sources was a priority for the camp's work. Almost all farms need new manure pits, lavatories and cesspools. Water quality improvement could be achieved through well deepening in those places where it is possible.

3. Development of the regional plan for well-head protection. Such a plan would map wells and develop standards for land use protection in the immediate radius of the well heads. It is very difficult to define the proper distance between the wells and the sources of surface pollution. The Ministry of Spatial Management and Building Industry regulation from 14.12 1994 regarding the technical conditions which should be respected by residential housing and its location says that the minimal distance between a well and a cesspool must be 15 meters. Nonetheless the wells are built on soils of different permeability and thus the standard distance is not always sufficient for a well's protection against pollution dissolved in migrating water.

The wells researched were characterized by the owners as dug wells, being covered with wooden bonnets, very rarely with concrete hatches. Water is pulled up from them by pipe. The wells' depths were defined by their owners as ranging between 4.5 meters and 15 meters. However many owners do not know the real depth of their wells, as they are not the first farm owners or they did not build them themselves. The owners are not interested in the technical state of their wells. The distance between the manure pit and cesspool was often 20 meters, sometimes 10 m and rather seldom 50 or 60 meters. The filtration coefficient is 0.4 m/h for this type of soil and that means that water gets to the tested wells very quickly. According to the underground waters pollution risk level classification, these waters could be qualified as very strongly polluted.

4. Designing and introduction of a community environmental educational plan for the citizens in the Malapanew River Basin, in particular for farmers. This educational plan includes: presentations, lectures and workshops; the development of literature, especially brochures and pamphlets; eco-theatre, presentation.

5. Presentation of conclusions for the Water Protection Program. The gradual improvement of the parameters determining water quality shows that the fight with non-point sources of pollution can only succeed by influencing the social awareness and growth of self-participation of the community in the creation of the local ecological policy. The research has shown that to improve the state of ecological awareness we do not need such much the basic knowledge from the field of environmental protection, but the creation of an ecologically conscious citizen, who is aware of the influence he can have on everything happening around him.

The company „Water Mains and Sewer Systems” from Opole, has shown some interest in the program presented. Water from sources located on the Tarnow Opolski communal territory is delivered to the Opole town water mains system. The Grotowice -Utrata area of the water sources is built from trias deposits with numerous outcrops and permeable layers. The quality of this water is high, but research indicates growing nitrate pollution. The water sources have got direct and indirect protection zones. The regulations concerned with the protection zones contain a lot of limitations and prohibitions, e.g. they forbid waste storage; limit the use of mineral fertilizers, mass domestic grazing of animals, use of the neighbouring roads for the transport of toxic and radioactive materials and so on. All these actions contributing to the protection of underground water pollution should be carried on with the agreement and active participation of the local citizens from Przywory, Miedziana and Katy Opolskie villages. Therefore the Eco-engineer Club is going to start the realization of the second part of the program. The project will identify and manage non-point source pollution in the protection area, which presently contributes to surface and subsurface water pollution. The goal will be achieved through basic research, development of social monitoring, establishment of a regional water management plan and an education project for the local citizens, especially members of the agricultural community.