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GROUND WATER POLLUTION AT THE NORTHERN PART OF HOCHIMINH CITY

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ABSTRACT

Through the investigation on water samples of 66 wells (digging and drilling) at northern part of Urban Inner City, we have noted that water from digging well cannot be used for household water supply. The parameters as NO_3^- , NO_2^- , NH_4^+ of these water samples have passed 5 to 10 times over the Vietnam standard limits. These samples have bad smell and high concentrations of harmful bacteria as digestive pathogen bacteria ($E. \text{Coli} > 100$ germes/100ml, total coliformes > 100 germes/100ml).

Water at the depth of -30 \rightarrow -40m is polluted with organic matters as NO_3^- , NO_2^- , NH_4^+ , PO_4^{3-} . These parameters are exceeding the limitation for domestic water use. In some area, bacteria mostly pollute drilling well water at old cemeteries, công Thanh landfill site, and the rehabilitation zone at Tan Thoi Hiep (District N^o12).

The urbanization and industrialization with cement cover surface have reduced the amount of replenished water and lowered the water table. In addition, the increasing of acid (lowered the pH of water) and the presence of iron with high quantity, cause the declination of ground water quality.

The number of drilling well for water increases day by day and the excessive water withdrawal have caused the contamination of well fresh water by the encroachment of salt water.

INTRODUCTION

HoChiMinh City like many other metropolis in Southeast – Asia is permanently becoming larger and larger urban agglomeration. The urban development and urban population growth itself may provide the increasing and higher dimension of urban – industrial, economical activities. The demand for life is higher and higher, so is the demand on water using.

The vulnerability of HoChiMinh City urban environment produces a numerous of human problems such as the distraction of the infrastructure, damage of agricultural areas.

Pollution of water and soil depends on:

- the high density of population
- urban - industrial expansion of urban – suburban space
- excessive and over exploitation
- negligence on natural resources exploiting and using.

The Northern part of HoChiMinh City includes Hoc Mon, Go Vap District, and District N^o 12. There are too many factories, agricultural areas and stock farms at the Northern part of HoChiMinh City. This is the focus area of City for agricultural and industrial production and new urban development. Nowadays, the vulnerability of studied area environment is lack of drainage capacity, hydraulic gradient of surface waters (canals and streams) and pollution of surface water. One of the major problems of this area is the demand on safe domestic and drinking water using. People in this area is using ground water at the depth of -5 ÷ -40 m.

The geohydrochemical analysis of the ground water can yield a historical record of contamination and pollution by various parameters. In some wells, data analysis of ground water alarm water in high polluted status.

- Water at the depth of -5 → -10m is no longer used. The parameters as NO_3^- , NO_2^- , NH_4^+ have passed 5-10 times over the standard level, water smell is too bad and density of harmful bacteria is got over the permission level.
- Water at the depth of -30 → -40m is polluted with organic and inorganic matters as NO_3^- , NH_4^+ , PO_4^{3-} , Cl^- and iron, which are exceeding the limitation for domestic and drinking water use.
- The urbanization and industrialization with cement cover surface, have reduced the amount of replenished water and lowered gradually the water table. Furthermore, water with low pH and the permanent presence of iron cause a declination of ground water quality. And the increasing of drilling wells, the excessive water exploiting have caused the contamination of ground water by encroachment of salt water.

MATERIALS AND METHODS

Locations selected for study

For the location, section and representative site of geohydrochemical investigation of ground water corresponding with:

- The economical characteristics of the Northern part of HoChiMinh City
- Industrial, agricultural and domestic waste water discharging concentration. Pollutions – point – area and diffuse sources.
- The excessive and over exploitation of ground water

the following section have been selected:

- The sections have high population density. There have been 25 studied ground water samples.
- The sections have population and many factories. The ground water exploited power is highest in there. The exploited power of a well is 1200 – 1600m³/hour. Industry is the largest withdrawer of water but not the largest consumer. Much of the water withdrawn for industry is became waste water after being used for cooling or other purposes. There have been 28 studied ground water samples.
- The sections have population and agricultural activities. Agriculture is the largest user of water due to irrigation and wash. All wells are small, the exploited power of them is slow, but water well density is highest. There have been 13 studied ground water samples.

Sampling and analytical methods

Ground water samples for determination of organic – inorganic pollutant parameter have been taken from March 1991 to December 1999. These samples were taken on two occasions: rainy reason (October) and dry reason (March) and were analysed many parameters in the following table:

	Parameter and substance
Physical properties	Temperature, colour, odor, dissolved solids, conductivity (EC)
Chemical properties	pH value, Hardness, Acidity, Alkalinity, dissolved CO_2
Chemical elements	(Na+K), Ca^{2+} , Mg^{2+} , HCO_3^- , Cl^- , SO_4^{2-} , PO_4^{3-} , Fe NH_4^+ , NO_2^- , NO_3^-
Heavy metal elements	Cr^{6+} , Cu, Al, Pb, Mn
Bacteria	Coliform, E.Coli, Coliformes Focs, Streptococcus foccalis

The concentration of heavy metal has been determined by Atomic Absorption spectrometer (AAS), all other parameters were examined by chemical and physico – chemical analytical methods. Bacteria have been examined by microbiological – parasitological methods.

Comparison bases on VIETNAM Standard : TCVN – TC20 - TCN – 1995

RESULTS AND DISCUSSION

Ground water quality

Ground water quality at the depth below -10m.

- Ground water, which is in aquifer below the surface at the depth of below -10m (< -10m deep), are exploited and used before 1989. All wells were dug with diameter < 1m. By the survey and analysis much of ground water at below -10m deep were polluted.
- The polluted parameters as NO_3^- , NH_4^+ , PO_4^{3-} , Fe, pH, have passed standard level and have values very high in the industrial, agricultural sections and specially highest at the areas near Dong Thanh landfill.
- The ground water samples, which have been taken along SaiGon river, Vam Thuat river, Ben Cat canal, have high salt concentration (>100mg/l) and are questioned the contamination of fresh well water by the encroachment of salt water
- Many of ground water samples have color, such as yellow, green, with bad smell and high density of harmful bacteria (specially digestive pathogen bacteria: E. Coli, total Coliformes...)

Ground water quality at the depth - 30 → - 40m

- All ground water samples, have been taken at -30 → - 40m deep, have low pH values ($\text{pH} < 5.6$).
- Many of ground water samples is polluted with organic and inorganic matters as NO_3^- , NH_4^+ , PO_4^{3-} , Cl^- and iron.
- Water with low pH value and permanent presence of iron (>0.3 mg/l) cause the complete change of ground water quality.
- The authors have noted that the polluted parameter concentration, such as NO_3^- , NH_4^+ , Fe total, Cl^- , SO_4^{2-} , becomes higher at the industrial, and agricultural areas according to the chemical results of ground water wells in the direction of North – North-West to South – South-East and West to East passed through industrial, agricultural and high population areas.

The changes of ground water quality

According to the depth

- The knowledge of the ground water quality changing according to the depth has been aware that the survey and the polluted parameter determination of two wells at the depth of below -10m and - 30 → -40m in a place and the same at other place.
- Water samples have been taken at shallower ground water layer, so were polluted all the higher limits. The cause of the high contamination are the near surface lying of ground water layer, the hand dig wells with large radius and the use and protection of wells no exact.

According to the time and season

In the same well, samples have been taken on two season per year and from 1991 to 1997, which indicated that concentration of polluted parameters is higher on dry season and on 1997 year, the same in other wells

The cause of ground water pollution

Sources of ground water contamination

- A variety of human activities stemming from agricultural, industrial, community and residential sources, as well as natural processes can contaminate ground water. Sources of contamination are referred to a point and nonpoint sources.

- Agricultural sources of contaminants include the use and storage of fertilizers and pesticides and disposal of animal and agricultural waste.
- Contaminants enter ground water from industrial sources such as deplorable housekeeping practices in the handling and transporting of materials and the use of surface impoundments to store, treat and dispose of wastewater and liquid wastes.

Hydrogeologic structure

By the surveying of hydrogeologic structure at studied area, the authors have noted that a non continuous impermeable layer at the top of ground water layer.

Contaminants enter ground water from:

- well points, in which the top of ground water layer are not protected by the impermeable layer,
- broken down wells
- polluted surface water sources (at Tham Luong, Ban Cat, Vam Thuat canals)

To lower the water table

The urbanization and industrialization with cement cover surface, the increasing of drilling wells and the excessive water exploiting have caused the contamination of ground water by encroachment of contaminants and have reduced the amount of replenished water and lowered the water table (-4 → -12m). Furthermore, water with low pH and the permanent presence of iron, cause the declination of ground water quality.

The population growth

The most important problem of surface area and ground water pollution at studied area is urban population growth and urban development.

CONCLUSION

This study has been carried out a part of an environmental geological research in the North part of Ho Chi Minh City. The pollution of ground water in studied area and in Ho Chi Minh City is proceeding higher and higher. From now on, it must have many plans to protect ground water sources.

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