WATER QUALITY IN THE WESTERN PART OF ROMANIA. REMOVAL OF PHENOL BY EXTRACTION

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Environmental protection has been one of the major problems of our society. The main objectives of the environmental policy are to protect human health, maintain biological diversity (bio-diversity), and manage natural resources to ensure their long-term use and preserve natural and cultural landscapes.

On the basis that prevention is better, than cure, the Basel Convention, signed by a large number of countries (1989), has emphasised the need for waste reduction. Waste minimisation can be realised through the implementation of low or non-waste technologies (cleaner technologies), i.e. the preventive strategy [1-2].

As we move into the twenty-first century, the use of technology to solve environmental problems will increase, but it will be applied in a different way than before. There is already evidence that the role of technology in environmental matters is changing in two important areas: sustainable development, dealing primarily with global problems and preventive technology, designed to reduce the environmental effects of processes, operations and products [3].

Water has been one of the fundamental sectors of the environment. As industry grew, rivers and oceans provided means of dispersing waste products from industrial processes. Nowadays, effluents from factories, waste materials dumped by ships, pesticides from agriculture and washings from old mines, all cause pollution of surface waters.

Because of water pollution, rivers downstream of factories and towns changed their characteristics, as well as lakes that were recipients of wastewater. When proper environment protection is not taken, this results in the environment pollution, especially surface water (rivers and lakes) and even the pollution of ground water.

Water quality protection has become an important problem all over the world and it is the subject of international co-operation. This problem has also had a great importance and complexity especially in the western part of our country.

The main factors of influence in this area are as follows: the rapid development of towns, both in population and in social-economic facilities. Chemicals used in agriculture, the large poultry and animal breeding farms-all these represent sources of significant wastewater amounts, containing harmful substances. Low dilution flows lead to the severe limitations for discharged wastewater. The majority of watercourses in that area is subject to international regulations and sometimes determine high fines because of excessive pollution.

As time went by, the water quality became substantially worse, having a negative influence on the water treatment for drinking and industrial purposes, and on aquatic life.

A prior and important part of our research tasks was to determine water quality characteristics for some rivers in the western part of Romania (rivers: Bega, Timis, Caras and Birzava). A significant part of that research was carried out as part of a United Nations programme (1976-1978). A series of water quality parameters in different sections of those rivers were determined: pH, dissolved oxygen, organic load, ammonia, phenols, suspensions, metallic ions, pesticides, etc.

Some of the parameters (ammonia, nitrite, phenols, iron, detergents, exceeded sometimes the level imposed by the Romanian standards for a river used as a source for water supply, especially downstream of Timisoara (Table 1). In addition, sometimes, high concentrations of pesticides and chlorinated organic compounds, TOCl, (0.25-0.80 mg/L) have been determined.

Table 1. Water quality parameters of Bega River downstream of Timisoara

No.	Parameter	Concentration, mg/L	
		Minimum	Maximum
1	Dissolved oxygen	0.00	7.70
2	Biological Oxygen Demand (BOD)	4.80	19.60
3	Chemical Oxygen Demand (COD)	4.40	15.30
4	Ammonia	2.00	13.20
5	Nitrites	0.00	0.51
6	Phenols	0.00	0.03
7	Detergents	0.02	0.17
8	Extractable substances	11.00	29.00
9	Iron	0.12	1.04
10	Manganese	0.01	0.08

To maintain the organic load within the levels imposed by Romanian standards, sometimes, large quantities of chlorine were necessary. It had the disadvantage of TOCl formation, which was extremely toxic, had corrosive effects on installation and influenced the taste of water. In this context, our team carried out research to promote advanced technology for sterilisation and oxidation of water and brought some contributions in this field.

The medium deep (10-75 m) aquifer, located in the Timis-Bega area (around 600,000 inhabitants in 1999), has been used as water supply since 1914. This source of water has had a good quality excepting the high concentration of iron and manganese, but these ions can be easily eliminated by means of a simple technological process.

The pollution sources are represented by industrial, agricultural and municipal wastewater. This wastewater is characterised by high and variable organic load, high amounts of total nitrogen, phosphorus and suspensions.

There is a great variety of industrial wastewater in the western area, especially in Timisoara and Resita, coming from metallurgy, petrochemical industries, galvanic depositions, paints and varnishes, detergents, food and textile industries, etc.

This wastewater with large and variable pollutant load had a negative influence both on natural waters and on downstream consumers. Hardly biodegradable organic and inorganic substances, metallic ions, etc. determined unpleasant social, economic and cultural effects on all ecosystems.

Another task of our team was the characterisation and treatment of various industrial and municipal wastewaters. Because of increased flow rates and toxicity, our preoccupation was to improve the treatment technologies. The aim of all these efforts was to improve water quality protection.

In this way, the extraction of phenols by selective solvents was applied to wastewaters coming from a wood distillery situated upstream of Timisoara. These waters are highly polluted with phenols (2.1-3.8 mg/L) and other organic substances (COD-Permanganate Method 7,900-13,000 mg/L).

The solvents used for the phenols extraction were butyl acetate, benzene and toluene in various schemes: simple counter current extraction, counter current extraction with raw and recovered (distilled) solvent and continuous extraction.

The experimental data showed that the most effective solvent was butyl acetate. The working conditions for all solvents were as follows: water/organic solvent ratio 7:3, temperature 25 °C and contact time of 5-10 minutes. The extraction efficiencies were 82% for butyl acetate, 60% for toluene and 67% for benzene. Two steps of extraction were carried out. The first step used recovered solvent and the second one used raw solvent. When the continuous extraction was used, the efficiencies of phenol removal reached 80%.

Extraction proved to be an effective method for phenols removal and it allowed the recovery of both phenol and solvent. On the other hand, the method required large quantities of solvent and quite complicated manipulation.

It is no doubt that the environmental protection is a very complex problem and therefore involves considerable research effort. We consider that the complexity of water quality problems requires the inter-and multidisciplinary studies, carried out by close collaboration among specialists from various scientific fields concerning water chemistry and technology.

REFERENCES

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