

XIV CONFERENCE ON PROGRESS IN WATER TREATMENT

organised by

POLSKIE ZRZESZENIE INŻYNIERÓW I TECHNIKÓW SANITARNYCH

and

THE INSTITUTE OF ENVIRONMENT PROTECTION ENGINEERING

The conference was held on 26-28 October, 1995 in Wrocław. The abstracts of the papers presented are published below.

JANUARY BIEN^{*}, LONGINA STĘPNIAK^{*}, JOLANTA PALUTKIEWICZ^{*}

EFFICIENCY OF WATER DISINFECTION IN ULTRASOUND FIELD

The ultrasound-field method is one of the nonconventional approaches to water disinfection. However, the results obtained so far have been insufficient to enable a reliable assessment of the method effectiveness. The disinfection effect depends crucially on the appropriate choice of the following parameters of sound process: ultrasound field intensity and time of its action. In the present study, the criterion adopted for assessing the efficiency of the ultrasound-field method was the disinfection effect observed with respect to three bacterial groups - bacteria belonging to the strain *Escherichia coli*, mesophilic bacteria and psychrophilic bacteria.

The efficiency of the ultrasound field was tested by prolonging the time of its action and varying the field strength. In the study use was also made of a combination of ultrasounds and disinfecting methods (ultrasounds + O₃ or ultrasounds + ClO₂), which was found to be promising.

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CO-REMOVAL OF MANGANESE AND AMMONIA NITROGEN ON A PYROLUSITE FILTER BED

The process took place in filters-reactors with bottom supply and co-current feed of compressed air. The filter beds were made of crushed pyrolusite. The treatment process involved nitrification of ammonia

nitrogen as well as autocatalytic oxidation and adsorption of manganese. Influent concentrations of ammonia nitrogen and manganese equalled 2.0–10.0 g N/m³ and 0.5 g Mn/m³, respectively, at hydraulic loads of 5.0, 7.5 or 10.0 m³/m²h, and an air to water volume ratio of 1 to 1. At initial concentrations as those mentioned above, the removal of NH₄⁺ and Mn²⁺ from drinking water was found to be effective due to the availability of oxygen along the whole profile of the filter-reactor. Kinetic evaluation of both nitrification and manganese removal made it possible to predict the bed depth required for an effective treatment of the water. Hydraulic load and grain size distribution ($d_g = 1.42\text{--}7.50$ mm) had no distinct influence on the efficiencies of nitrification and manganese removal. This is an indication that the growth of nitrifying bacteria may have an adverse influence on the efficiency of manganese removal from water.

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MARIAN BŁAŻEJEWSKI*

ON THE UTILITY OF HYDROGEN PEROXIDE IN REMOVING IRON COMPOUNDS AND AMMONIA NITROGEN FROM GROUND WATER

The problem of an efficient ammonia nitrogen removal pertains to about 10% of the Quaternary water taken in for municipal supply. Conventional treatment trains comprising aeration and single-stage or two-stage filtration provided insufficient removal efficiencies, so it seemed advisable to investigate the utility of hydrogen peroxide as the oxygen source for nitrification on an activated carbon bed. Model-scale experiments substantiated its usefulness as an oxygen source for the nitrification process in a two-stage filtration system, with iron and manganese removal at the first stage, and nitrification of ammonia nitrogen at the second stage of the process. It was found that when the second stage involved an activated carbon bed, it was advantageous to replace the aeration process by the addition of hydrogen peroxide before the first-stage filter. Addition of hydrogen peroxide prior to the water passage through the activated carbon bed deactivates nitrifying bacteria.

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JOLANTA BOHDZIEWICZ*, MICHAŁ BODZEK*, JANUARY BIEN**

ASSESSING THE POTENTIALITY FOR CHROMIUM REMOVAL FROM WATER BY REVERSE OSMOSIS

The primary objective of the study was to separate chromium compounds from the water drawn for municipal supply. Another objective was to assess the efficiency of chromium separation by reverse osmosis involving polymeric membranes of the SEPA-S type. The membranes were cast from cellulose acetates differing in the degree of acetylation and, consequently, in viscosity as well as in the hydrophilic properties of the starting polymer (Fluka, Serva, Kodak CA-E-398-3, Kodak CA-394-30). There was

investigated the contribution of some major technological parameters that may affect the physicochemical properties of the membranes (composition of the casting solution, conditions of solvent evaporation from membranes, conditions of gelation, conditions of thermal modification) to the values of permeate flux and the factor of chromium retention. For the sake of comparison, a similar experimental series was run with Osmonics Inc. membranes (USA). At the final stage of the study, the most advantageous operating parameters (transmembrane pressure and flow rate of aqueous solution over membrane surface) were determined. Reverse osmosis was carried out in a batch system, using a NUCLEOPORE apparatus.

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MIECZYSLAW CHOMA *

ENERGETIC HETEROGENEITY OF ACTIVATED CARBONS

Systematic studies of the energetic heterogeneity of porous activated carbons were carried out, making use of the adsorption energy distribution function. This distribution was calculated numerically by a regularization method for a variety of carbons. Analysis of the distribution functions obtained provided information about the energetic heterogeneity of the carbons studied, permitting their classification in terms of mono- and bi-modal distributions. It was also shown that energy distributions obtained from the adsorption isotherms of nitrogen and argon were similar.

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ZYGMUNT DĘBOWSKI*, JOANNA LACH*

REMOVAL OF CHROMIUM COMPOUNDS FROM WATER ON A DOMESTIC ACTIVATED CARBON

The objective of the study was to assess the utility of a domestic activated carbon (marketed under the brand name of WD-extra) in removing hexivalent chromium from aqueous solutions. It was found that the efficiency of chromate anion removal increased noticeably, when WD-extra had been modified by removing the excess ash of an alkaline pH by means of sulphuric acid. To decrease the chromium concentration in water from 2-4 g Cr⁶⁺/m³ to the admissible value for drinking water it is necessary to apply at least a 3-minute water flow through the activated carbon bed and a flow velocity equal to, or lower than 4 m/h.

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HENRYK DERA*

DISINFECTION OF INFILTRATION WATER WITH
CHLORINE DIOXIDE AT THE WATERWORKS OF OŚWIĘCIM

The advantage of applying chlorine dioxide instead of gaseous chlorine for the disinfection of potable water was shown on the example of the Zasole Water Treatment Plant, Oświęcim. The plant makes use of an infiltration water intake (at the river Soła). Physicochemical and bacteriological analyses (carried out both for untreated and treated water samples) corroborated the need of substituting chlorine dioxide (produced by the reaction of hydrochloric acid and sodium chlorite) for the gaseous chlorine which had been used so far. A new water disinfection station which uses chlorine dioxide produced via a Bello-Zon CDK-300 generator (made by ProMinent, Germany) is described in detail and relevant costs are assessed.

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ORGANIC POLLUTANTS IN THE DRINKING WATER OF WARSAW

The Warsaw Waterworks make use of polluted water intakes situated at the river Vistula and the Zegrzyńskie Lake. In untreated and treated water samples, the presence of toxic organic species was examined. The concentrations of organochlorine pesticides, polychlorinated biphenyls, phenols with their methyl and nitro derivatives, chlorinated benzenes, and polynuclear aromatic hydrocarbons were determined by GC and, in some instances, by GC/MS methods. Due to the treatment there was stated a decrease in the levels of pesticides, polychlorinated biphenyls, phenols (with their methyl and nitro derivatives) and polynuclear aromatic hydrocarbons, but concentrations of volatile chlorinated hydrocarbons and chlorinated benzenes were found to increase.

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FORMATION OF ALDEHYDES IN THE COURSE OF THE OZONIZATION PROCESS

The disinfectants used in water treatment react with natural organic matter to form aldehydes. Of the oxidants, which are in use now, ozone contributes to the formation of the highest concentration of aldehydes. Many of these compounds are mutagenic (e.g., formaldehyde, acetaldehyde or glyoxal). Analysis of aldehydes is difficult due to their polarity and low concentration (ppb, ppt). Direct aqueous derivatization with PFBOA (O-(2,3,4,5,6,-pentafluorobenzyl)hydroxylamine) was found to be useful for analysis. The objective of this study was to find the relationship between the formation of ozonization by-products and the treatment conditions (ozone dose, contact time) and raw water type (pH, alkalinity, temperature, TOC). The experiments were run with surface-water and ground-water samples. Aldehydes were analyzed

by the PFBOA derivatization method and the GC-ECD technique. Production of aldehydes was proportional to the ozone/TOC ratio, and decreased with the increasing ozone dose. Aldehyde formation depended also on pH value: lower amounts of aldehydes were produced at higher pH. Alkalinity was found to have no effect on aldehyde formation.

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THE PRAGA WATERWORKS OF WARSAW AND THEIR ACHIEVEMENTS IN RIVER WATER INFILTRATION

In September 1994, the Praga Waterworks celebrated their thirtieth anniversary. The technological train in the Waterworks includes infiltration of the Vistula river water, aeration, rapid filtration and disinfection. The under-bottom infiltration intakes are of a special and unique design. In the past thirty years, many innovations have been developed and implemented to optimize the infiltration process and the treatment train as a whole. The paper summarizes the experience gained from 30-year operation of under-bottom intakes.

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SOME PROBLEMS OF GROUND WATER TREATMENT IN POLAND

In this paper, use was made of the data collected over 20-year experience in the research, design and operation of ground water treatment plants in Poland. Particular consideration was given to some problems dealt with in aeration of ground water as well as in the process of iron and manganese removal. As far as aeration is concerned, attention was focused on the application of high-efficiency devices, e.g., the Białystok nozzle and the aerating cascade. A detailed discussion was devoted to the efficiency of iron and manganese removal during water filtration through a variety of filter beds. The conditions of backwash were also discussed.

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APOLINARY KOWAL*

PARASITES – A HAZARD TO PUBLIC WATER SUPPLY SYSTEMS

Bacteria, viruses and protozoa create serious hazards to a water supply system. Many parasites can be transported with water, thus spreading infectious diseases, or even epidemics. Of the many diseases spread via water supply, two are particularly dangerous – cryptosporidiosis and lambliaosis caused by

Cryptosporidium parvum and *Giardia lamblia*, respectively. In this paper, particular consideration was given to the occurrence of parasites in surface water intakes from which water is drawn for municipal supply. Those parasites are difficult to identify. Many of them are resistant to a variety of disinfectants used in water treatment, so they are able to survive highly sophisticated technological trains. On the basis of these findings, the importance of effective suspended solids and turbidity removal as well as the role of the disinfection process were discussed.

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TADEUSZ KOWALSKI*

ON THE CHEMICAL PARAMETERS OF WATER POLLUTANTS AND THEIR EFFECT ON THE CHOICE OF COAGULANTS

Although the physicochemical phenomena concomitant with alum or iron-salt coagulation are similar, the products of the dissociation or hydrolysis of the two coagulants follow different behavioural patterns. Thus, those of alum are prone to form (predominantly) slightly soluble salts with the iron-humus complexes present in the water. These reactions are slightly delayed due to the reactions concomitant with complexing, i.e., mutual replacement of calcium and magnesium (depending on water parameters). And this enhances the reaction of the coagulant with other pollutants, which manifests itself in a slight decrease (by 20%) in the efficiency of organic matter removal. The products of the dissociation and hydrolysis of the iron-salt coagulant are prone to form partly soluble iron-humus complexes. These reactions are also combined with the aforementioned exchange of calcium and magnesium, but the deterioration of organic matter removal is considerable (by 40%). On the basis of those findings the following generalizations can be made: when the water to be treated carries a variety of polluting species, alum coagulant is preferable, because iron salts may produce considerable variations in the efficiency of organic matter removal (60–90%). When humic substances are the dominant polluting species, it does not matter whether alum or iron salt is used as coagulant.

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GRZEGORZ KOZMIŃSKI*, KAROL KUŚ*

OPERATION OF BACKWASH-WATER PULSATORS AT THE TREATMENT PLANT OF GOCZAŁKOWICE: TECHNOLOGICAL AND ECONOMIC CONSIDERATIONS

Making use of the results of model investigations, a new solution to the problem of backwash-water pulsator operation was proposed. The following items were analyzed: treatment of backwash water, technical conditions of rapid filter backwash (for the two technological trains applied at the Water Treatment Plant of Goczałkowice) and energy demand for the backwash process. On this basis, a block method for

the process and a non-continuous water supply to the pulsators were proposed. Economic considerations were carried out to verify the worthwhileness of the solution proposed.

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ZBIGNIEW LEPKOWSKI*

TECHNOLOGY OF ODRA RIVER WATER TREATMENT FOR MUNICIPAL SUPPLY IN THE CITY OF SZCZECIN

The new waterworks for the city of Szczecin (which are now under construction) will make use of an intake drawing highly polluted water from the river Odra. In this connection, pilot-scale investigations were carried out to support the design of the technological train. The paper presents the results of investigations (first of that type in Poland) which aimed at intensifying the treatment of highly polluted river water before its passage to the activated carbon filters.

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JANUSZ ŁOMOTOWSKI*

THEORETICAL BACKGROUND TO THE PROBLEM OF IRON-COMPOUND WASHOUT FROM THE AQUIFER

It has been shown that at the second stage of iron washout from the aquifer, the variations observed in ground water concentrations of iron compounds can be described by a parabolic function. At the third stage, the average values of iron concentration in ground water (established on the basis of several periods characterized by similar dynamics of ground water table variations) are described by geometrical progression with the quotient $\exp(-\beta T)$. The half-time of iron-compound washout from the aquifer varies from about 350 to 3104 days, at an average value of about 3.7 years.

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MAREK MIELCZAREK*

WATER DISINFECTION WITH CHLORINE DIOXIDE

The latest EC Directive Governing the Quality of Drinking Water (1994) reflects the trend towards complete removal of chlorinated hydrocarbons from drinking water. For these reasons, great effort has been made to search for alternatives to chlorine. Chlorine dioxide is one of these alternatives. The paper

includes a comparative analysis of oxidation and disinfection by means of chlorine and chlorine dioxide, points to the wide application of chlorine dioxide in water treatment for different purposes and presents a technical solution to the problem of water disinfection by means of ClO_2 .

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PREOXIDATION OF WATER POLLUTANTS IN THE NORTHERN WATERWORKS OF WARSAW

The Northern Waterworks draw surface water from the Zegrzyn Impoundment Lake (which is fed by two rivers – the Bug and the Narew), thus increasing the volume of water supplied to the Municipality of Warsaw by 140,000 to 180,000 m^3/day . The impoundment water is characterized by a very high coloured matter content with dominating humic substances. A variant system developed for the treatment of this water includes coagulation with alum or iron as flocculants and rapid filtration through sand beds. Since the polluting species are difficult to remove, preoxidation is required as a prior step. Prechlorination or preozonation, applied during the two-year span from 1992 to 1994, yielded good efficiencies of colour and organic matter removal. Prechlorination with low chlorine doses ($3 \text{ g}/\text{m}^3$) in 1992 was not very effective – plankton removal was insufficient, and THM concentration in the water (at an over 48-hour flow from the intake to the user) after final disinfection increased considerably in the summer season. In 1993 and 1994, after prechlorination had been replaced by preozonation, THM content was decreased by 40% and 30%, respectively, as compared to 1992. In 1994, the increase in ozone dose (without increasing the coagulant portion) raised the efficiency of organic matter removal (COD and UV absorbance) despite shortening the time of water flow through the treatment plant by about 27 h. It should be noted that neither prechlorination with low chlorine doses nor preozonation was found to aid the coagulation/sedimentation and filtration processes in an efficient plankton removal. The problem of how to remove phytoplankton is still far from being solved satisfactorily.

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MX – HIGH-ACTIVITY MUTAGEN IN DRINKING WATER

There is presented a detailed account of reports on MX (3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone) which have been published since 1991. The interest in this mutagenic species grows considerably all over the world. The experimental substantiates a higher vulnerability of ECD to MX derivatized by pentafluoropropanol than to methylated MX. To detect the presence of MX in the drinking water of Poznań use was made of GC/MS in the SIM mode. Together with MX, we identified a number of compounds of a similar structure.

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URSZULA OLSIŃSKA*, ANTONI OLSIŃSKI*

ON THE CONTRIBUTION OF OZONE AND HYDROGEN PEROXIDE DOSING TO THE FORMATION OF BROMATES

The ever increasing interest in the ozonization of drinking water has directed the attention of environmental scientists and engineers to the potentiality of health implications, because some undesirable by-products may be formed in the course of the process. This potentiality raises serious concern when the water to be ozonized contains bromides. Taking account of the above, we performed laboratory tests to find out how the configuration of the ozone contactor may affect the formation of bromates in bromide-containing water. The tests involved two types of ozone contactors (with and without supplemental mixing). There was also investigated the effect of simultaneous application of ozone and hydrogen peroxide on the amount of bromates formed in the course of the ozonization process (special consideration being given to the problem of how to reduce this amount). The experiments have led to the following findings: The formation of bromates during ozonization of bromide-carrying water can be brought under control by optimizing the configuration of the ozone contactor and the conditions of mixing (supplemental mixing) as well as by combined dosing of hydrogen peroxide and ozone.

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ANDRZEJ PAWUŁA*

ENVIRONMENTAL HAZARDS DUE TO RADIOACTIVE CONTAMINATION OF WATER

The sources and biological effects of ionizing radiation are characterized. Apart from man-made radiation, human beings and their environment are exposed to geological and cosmic rays. Exposure to natural radionuclides is strictly associated with economic activity. The annual intake of ionizing radiation has increased twofold in the past 30 years, averaging 3.6 m Sv/a. In terms of CIPR-ICPR standards, the maximum permissible dose during 30-year span must not exceed 50 mSv, its annual dose amounting to 1.67 mSv. If the time of exposure is shorter, the permissible dose amounts to 5 mSv/a. According to WHO guidelines, the annual radiation dose received via drinking water should not exceed 0.1 mSv. A preliminary radiological criterion for potable water involves total alpha-activity or total beta-activity of ≤ 0.1 Bq/dm³. In Poland, radiological hazard is concomitant with intakes fed by river water. Such preventive measures as construction of ground water intakes, which provide potable water of a higher quality, and implementation of a more economic distribution of drinking water are suggested.

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MALGORZATA PERCHUĆ*, TERESA ZIÓLKOWSKA*

ON THE TREATMENT OF GROUND WATER WITH HIGH COLOURED MATTER CONTENT

Taking into account the ever increasing water deficit, the potentiality of using Miocene waters for the purpose of municipal supply is considered. Miocene waters are characterized by the following parameters: high stability, high iron and manganese concentrations and large amounts of organic matter. Col-

oured matter content is particularly high, with humic substances as the main contributing factor. The presence of humic substances is responsible for the yellowish brown colour, for the increased COD and for the formation of humic acid-iron or humic acid-manganese complexes which are difficult to remove. The concentrations of humic substances in Miocene waters drawn from brown coal formations in some instances amount to several hundred grams per cubic meter. Miocene water is hardly ever amenable to treatment, and often requires application of sophisticated treatment trains. The choice of the treatment method depends on the form of these pollutants that deteriorate the quality of the water. The Miocene waters under study were drawn in Warsaw and its immediate vicinity. They varied in composition from one intake to another, thus requiring an individual treatment train, because – in raw condition – they were not fit for municipal supply. The technological trains proposed for the treatment of Miocene water were similar to the conventional ones. They were to create favourable conditions for the oxidation of iron and manganese (and, thereafter, for their mechanical retention on appropriately selected filters) or for the separation of organics. The number of unit processes included in the treatment train varied with the composition of the water to be treated and with the final quality desired. Water coagulation on a sand bed was often found to be successful.

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FLORIAN PIECHURSKI*, KAROL KUŚ*

ON THE UTILITY OF MAGNETIZERS IN THE REMOVAL OF ENCRUSTATIONS FROM GALVANIZED STEEL WATER-MAIN PIPES

After several years of operational use, steel pipes carrying cold or hot water for municipal supply suffer from corrosion and encrustation processes. Serious problems arise when municipal water is drawn from surface-water intakes. Although many devices of different designs are available for the needs of magnetic treatment, there is still a lot of doubt as to whether or not they are sufficiently effective in preventing encrustation. The objective of the study reported was to assess the efficiency of encrustation removal from water-mains made from galvanized steel and exposed to the influence of magnetizers. The results obtained by hydraulic and gravimetric methods showed that old encrustations were dissolved with a good efficiency.

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ANDRZEJ RUTKIEWICZ*

TAP WATER PARAMETERS AND SERVICE LIFE OF WATER MAINS IN POLAND

Corrosion hazards to the water mains of 25 district municipalities were investigated under the INSTAL Project during the two-year span from 1992 to 1994. Consideration was focused on the prediction of corrosion resistance for steel, galvanized steel and copper – three basic materials used in the produc-

tion of water pipes. The contribution of some chemical substances present in the tap water to the length of pipe service life was examined, and a number of suggestions were forwarded to the Ministry of Health and Social Welfare. One of these was the increase in pH from (6.5–8.5) to (7.0–8.5), which would encourage widespread use of copper pipes without the risk of raising the copper ion content in the tap water above the admissible level. Such an increase in pH would also inhibit further corrosion of galvanized steel pipes which have been widely used so far.

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MICHAŁ SAWICKI*

QUALITY OF DRINKING WATER ACCORDING TO POLISH AND GERMAN DIRECTIVES

The paper gives a critical account of Polish directives governing the quality of drinking water. Many of them are purely theoretical because of unrealistic date of their enforcement, or because of the lack of adequately equipped laboratories in the majority of waterworks. Particular attention has been focused on the application of strong oxidants to water treatment – a problem that has been solved satisfactorily in Germany. According to German directives, the application of chlorine, sodium hypochlorite and chlorine dioxide must be limited to the purpose of disinfection alone, and – furthermore – these species must not be used for the preoxidation of water pollutants. German directives also define a strict admissible total chlorine and total chlorine dioxide doses (for the entire process including water treatment and water distribution), which amounts to $1.2 \text{ g Cl}_2/\text{m}^3$ and $0.4 \text{ g ClO}_2/\text{m}^3$, respectively. The author suggests how to adjust those directives in order to make them workable also in Poland.

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CHEMICAL COMPOSITION OF WATER PIPE ENCRUSTATION

Samples of encrustation which had been deposited during service life in the water-pipe network of Wrocław were investigated. The main component of both fresh and old encrustations was found to be iron compounds, the products of the corrosion process. This finding was additionally corroborated by the lack, or by very low content, of carbonates and calcium. Of the anions present, silicates dominated in terms of quantity. Heavy metals occurred in trace amounts. Analysis of cation and anion content in fresh and old encrustation samples showed that iron and sulphur compounds were dominant in old deposits, whereas manganese, aluminium, magnesium, zinc, cobalt and nickel dominated in fresh encrustation. From the analysis of the solubility product values it may be inferred that the investigated metals occurred predominantly in the form of hydrated oxides, sulphates and silicates.

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JAN SZPAKOWSKI*

WATER QUALITY IN THE INTAKES AT TWO IMPOUNDMENT LAKES – SOLINA AND MYCZKOWCE

Both impoundment lakes are fed by the river San. For the purpose of the study, six sampling sites were established at the Solina Lake, three at the Myczkowce Lake and eleven at the tributary streams. Samples were taken three times a year. Analyses were carried out for 41 physicochemical and four bacteriological parameters. During the span of 22 years there has been stated a continuing increase in colour intensity and pH, in the concentrations of calcium, sulphates, BOD₅, COD, ammonia nitrogen, nitrates, organic nitrogen, phosphorus and phosphates, but primarily in bacterial growth. The present condition of the impoundment lakes and their tributaries calls for immediate remedial measures – an appropriate management of wastewater discharges as well as further qualifying/quantifying monitoring of the polluting species, which occur at highly variable concentrations. It should be noted that there is recirculation of water between the two impoundment lakes.

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BOŻENA TOCZYŁOWSKA*

DOMESTIC FILTERS: ASSORTMENT AND APPLICATIONS

In the past few years, the poor quality of drinking water has considerably increased the demand for domestic filters in Poland. Point-of-use devices (POU) are installed only for taste and health reasons, but they are replaced by point-of-entry devices (POE) or point-of-entry/point-of-use systems (POE/POU). The objective of installing POE units is also to provide long-term service ability and reliability of domestic drinking-water systems. The paper gives an account of POE devices which can be used in the household, as well as a list of factors which should be considered when choosing the method of treatment and the device to be applied. A major component of the POE system is a mechanical filter.

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JACEK WAŚOWSKI*, ANNA GRABIŃSKA-ŁONIEWSKA**

RECONTAMINATION OF WATER IN THE MUNICIPAL SUPPLY SYSTEM OF THE CITY OF WARSAW

With the passing of service time, an encrustation layer on the internal walls of the water pipes and mains becomes thicker due to the deposition of chemicals and microorganisms. The intensity of the process depends on two major factors – the quality of the water transported through the pipeline, and the material of which the pipes have been made. The undesirable effects produced by the contact of the

flowing water with the pipe interior can be itemized as follows: corrosion, encrustation as well as penetration of corrosion products and metabolites (concomitant with biological growth in the pipes). These phenomena contribute to the recontamination of the treated water, manifesting themselves in a noticeable deterioration of its quality. They also contribute to the appearance of corrosion-induced perforation of the pipes and to the decrease of their internal diameters. According to the results of our investigations, the deterioration of water quality was particularly high in the mains and plumbings made of zinc-coated iron. Even after a short time of service, there was not only a dramatic deterioration of the physicochemical and bacteriological parameters of the water, but also considerable changes were observed on the internal walls of the pipes. All those adverse effects resulting from the aggressiveness of the water supplied were noticeably reduced when plastic pipes had been used. Polypropylene (PP3) pipes eliminated corrosion phenomena and provided the user with water of an upgraded quality with respect to those parameters that are undesirably influenced by electrochemical and microbiological corrosion.

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KRZYSZTOF WILMAŃSKI*

ACTIVATED CARBON FILTERS IN THE WATER TREATMENT PLANTS OF POLAND: ECONOMIC CONSIDERATIONS

The use of activated carbon beds in water treatment implies rising expenditure on the construction of filters as well as on the purchase and routine regeneration of activated carbon. The costs involved will far exceed the optimal ones, if activated carbon is used incidentally or inappropriately. But if the investment problem is approached and considered thoroughly (as well as corroborated with relevant investigations), there may be noticeable savings. In this paper, consideration is given to some major factors that affect the costs of using activated carbon in water treatment. Those contributing factors can be itemized as follows: quality of the influent water, technology and efficiency of pretreatment, type of the activated carbon used, operating parameters of the filter bed and conditions of carbon regeneration. Relevant experiments have been run on laboratory, pilot and industrial scales in various parts of the country for many years. Use has also been made of literature reports. A rough cost analysis was carried out for the Dzieżkowice Water Treatment Plant involving activated carbon filters. Three methods were adopted for the operation of the adsorption system. Of these, the one suggesting that spent carbon should be regenerated at the water treatment plant was found to be the cheapest method. And this method has been used ever since.

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MICROBIOLOGICAL METHOD OF PRODUCING IRON COAGULANT

In the method proposed, a ferric coagulant is produced by *Thiobacillus ferrooxidans* which oxidizes Fe(II) to Fe(III). This reaction involved iron concentrations varying from 11 to 50 g FeSO₄·7H₂O/dm³, and was carried out in three bioreactors, each packed with a 200 cm³ volume of GAC. Air was supplied

from the bottom through a ceramic layer. The bioreactors had been placed in a thermostat at 23 °C. The experiments were run in a non-sterile environment. The strain utilized for the purpose of the study was a mixture of acidophilic bacteria which were capable of oxidizing iron. They were isolated from a heap of ferrous sulphate wastes. The optimum pH of the ferrous sulphate solution was found to be 1.3. The degree of conversion as well as the efficiency of the oxidation process were related to the rate of dilution and to the concentration of the ferrous sulphate solution applied. There was determined the minimum conversion of iron required for the coagulant which is to be used in the water treatment process. Jar tests have substantiated the utility of the ferric flocculant obtained via the above route in the coagulation of surface water.

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ROBERT ZAMAJSKI*

ON THE USE OF UV TECHNIQUES IN WATER DISINFECTION

In the past decade, microbial contamination of watercourses in Poland has become increasingly frequent. UV disinfection is a modern and reliable technique, enabling us to overcome successfully contamination hazard. This paper provides some basic information about the fundamental UV parameters, e.g. UV-C radiation, transmission, UV dose, level of germicidal efficiency, etc. The utility of low-pressure (LP) and medium-pressure (MP) lamps in the disinfection of drinking water is discussed in detail. The application of UV systems involving MP lamps was found to be particularly advantageous in the disinfection of potable water at a flow rate higher than 150 m³/h, and in the disinfection of troublesome wastewaters. An interesting mechanism of scale removal without discontinuing the operation of the system is also presented. A brief discussion is devoted to the experience in UV techniques in Poland as well as to the UV cylinders of a 5 to 30 m³/h capacity designed by the author of this paper.

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ALEKSANDRA ŻELECHOWSKA

CONTROL OF TOXIC ORGANIC COMPOUNDS IN SURFACE WATER

The availability of information on the occurrence of toxic species in the aquatic environments of different developed countries and Poland was compared, and so were the methods of toxic substance control. Since a reliable environmental data base is still lacking in Poland, risk areas were defined in terms of the COD/BOD₅ index in wastewater discharges from point sources. It was found that the application of the bacterial Microtox test would noticeably improve the effectiveness of toxic discharge control.

sis of environmental control strategies in developed countries has revealed that the idea of the buffer capacity of the ecosystem is being abandoned, preference being given to relevant preventive measures.

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LESŁAW ZIĘBA *

ON THE QUALITY OF POTABLE WATER IN POLAND

Polish sanitary regulations and drinking water quality standards are compared to those of the EC countries, WHO and USEPA. Special consideration is focused on potential health implications due to low quality of potable water, low quality of food or polluted air. Taking into account any hazard resulting from the consumption of water of low quality, a number of criteria for the assessment of potable water quality are discussed. A detailed comparative analysis of relevant instructions issued by WHO, European Community and Polish Ministry of Health and Social Welfare shows that Polish sanitary regulations pertaining to drinking water quality need to be amended. In this context, detailed recommendations and criteria have been formulated.

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