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APOLINARY L. KOWAL*

INFILTRATION AND WATER TREATMENT

The paper presents an account of major infiltration methods. In more detail there are analyzed bank infiltration, artificial infiltration and bottom infiltration, as well as their inherent advantages and drawbacks. There are also indicated uses where infiltration is applicable in Poland and in other countries. In Poland, use is made of infiltration ponds for the needs of artificial infiltration. Bottom infiltration, carried out at the intakes of water from the Vistula, is regarded as highly effective, as it can be inferred from the examples of the water intakes for the city of Warsaw. According to the author of the paper, infiltration is recommendable for drinking water intakes because of the increasing ground water deficit and also because of the ground water parameter variations in the case of excess water intake (examples are provided and discussed in detail). In Poland, infiltration water is not subject to pretreatment, but liming of the infiltration water intake area (e.g. in Legnica, Lower Silesia) has reduced iron and manganese concentration of the infiltering water, thus enabling the content of the two species to be decreased to trace amounts via aeration and filtration.

*Institute of Environment Protection, Branch of Wrocław, Wybrzeże Wyspiańskiego 39a, 50-370 Wrocław, Poland.

MARIA ŚWIDERSKA-BRÓŻ*

SOME MAJOR PROBLEMS IN WATER TREATMENT FOR DRINKING PURPOSES

The main problems of drinking water treatment and selected micropollutants' removal are presented. The paper gives an account of the available methods and new technological trends securing the drinking water standards. It should be noted, however, that the application of efficient and safe water treatment

methods, enabling elimination of polluting species which are difficult to remove, are often concomitant with troublesome modifications of the treatment trains, thus raising the overall treatment cost.

*Institute of Environment Protection Engineering, Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland.

JERZY CHOMA*, MIECZYSŁAW JARONIEC**

NEW METHODS ENABLING DESCRIPTION OF THE POROUS STRUCTURE OF ACTIVE CARBONS ON THE BASIS OF ADSORPTION DATA

The porous structure of the MAXSORB 20-SPD active carbon was characterized using nitrogen adsorption isotherm at 77 K in a wide range of relative pressures (10^{-7} to 0.995). It was shown that analysis of the distribution function of the adsorption potential permits evaluation of the total specific surface area, micropore volume and average micropore size. For many active carbons the adsorption potential distribution function has two peaks; one of them corresponds to the monolayer formation on the surface of the micropore walls, and the other one reflects the volume filling of the micropores. The minimum between these two peaks can be identified as the point of the monolayer completion. It allows calculating the total specific surface area of the active carbon, which agrees with that evaluated on the basis of the DTF method. Assuming the model of slit-like pores it is possible to determine also the average pore size. It appears that the adsorption potential distribution can be of utility in characterizing the porous structure of active carbons.

*Military Technical Academy, Institute of Chemistry, ul. Kaliskiego 2, 01-489 Warszawa, Poland.
**Separation and Surface Science Center, Department of Chemistry, Kent State University, Kent, Ohio 44242, U.S.A.

MAREK MOŁCZAN*

ORGANIC MATTER REMOVAL BY ADSORPTION AND BIODEGRADATION ON GAC FILTER BEDS

Activated carbons are applied in water treatment owing to their specific properties, i.e. their internal structure, which is characterized by a specific surface. Macroporous carbons accumulate 1.5 to 3 times as much biomass capable of degrading organic matter as microporous carbons, which have a better capacity of removing dissolved organics (DOC). The experiments reported in this paper were carried out at the pilot plant of the Wrocław Waterworks, using samples of infiltration water (which had been treated by aeration and sand filtration), as well as micro- and macroporous GAC beds. The contribution of adsorption and biodegradation to the efficiency of organic matter removal was assessed. The utility of the two carbons when applied to water treatment was also analyzed.

*Institute of Environment Protection Engineering, Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland.

WIESŁAW ZYMON*, JERZY KURBIEL*

EFFECT OF SILICA CONTENT IN WATER ON THE ADSORPTION OF POLLUTANTS BY ACTIVATED CARBON

The authors concentrate on the problem of how the quality of raw water affects the efficiency of the adsorption process when used for the removal of organic pollutants. Experience has often taught that even

though the physicochemical parameters of the water to be treated encourage us to applye particle filtration on activated carbon beds for organic matter removal, the efficiency of the process appears to be low. Technological investigations of an appropriate choice of activated carbon have revealed that silica dissolved in water may polymerize until it becomes colloidal in form. Polymerized silica adsorbs in the activated carbon, thus depleting its adsorbing capacity. To make the activated carbon work effectively it is necessary to remove silica prior to the adsorption process.

*Institute of Water Supply and Environmental Protection, Cracow University of Technology, ul. Warszawska 24, 31-155 Kraków, Poland.

JACEK NAWROCKI*

ADVANCED OXIDATION PROCESSES IN WATER TREATMENT

Advanced oxidation processes (AOP) are reviewed in the context of organic matter removal, especially of low-molecular-weight toxic substances, from water. The mechanism governing the AOP involves the oxidizing potential of hydroxyl radicals. Free radical reactions, O_3/H_2O_2, H_2O_2/UV and O_3/UV processes, Fenton's reagent, as well as photochemical and photocatalytic methods of oxidation are discussed in detail. Making use of the data reported and of the results obtained in his own studies, the author of the paper draws attention to the applications of AOP, particularly to the removal of organic substances which are not amenable to conventional treatment.

*Research Group for Technology of Water Treatment, Adam Mickiewicz University in Poznań, ul. Drzymały 24, 60-613 Poznań, Poland.

EDWARD ZBIEĆ*, JAN R. DOJLIDO*

BY-PRODUCTS OF WATER DISINFECTION

Three oxidants – chlorine, chlorine dioxide and ozone – have found wide acceptance in water disinfection. Of these, chlorine has been preferred for the past decades. Unfortunately, chlorine has the inherent disadvantage of reacting with the micropollutants present in the water to produce derivatives of the halogen group, which are all cancerogenic or mutagenic compounds. Thus, in order to overcome the problem of chlorine derivative formation, the use of ozone as disinfectant has become more and more frequent. But it soon became obvious that the reaction of ozone with water pollutants yielded equally hazardous products, mostly carbonyl derivatives and bromoacetonitriles. Although ozone is a strong biocide, it is seldom used singly because of its instability. The most frequent use of ozone as disinfectant is in combination with chlorine or chlorine dioxide, which, again leads to the formation of a number of toxic by-products. The mechanisms that govern the production of these toxic species or are responsible for their toxicity have not been satisfactorily explained yet. The authors of the present paper provide a detailed account of the chemical compounds produced in a variety of Poland's waterworks in the course of the disinfection process. Particular consideration is given to the water treatment plants of the city of Warsaw, where use is made of chlorine, ozone and chlorine dioxide as disinfectants. There are also presented the potentialities for determining the by-products in potable water.

*Institute of Meteorology and Water Management, ul. Podleśna 61, 01-673 Warszawa, Poland.

TOMASZ PODSIADŁY*

GENOTOXICITY OF DRINKING WATER FROM SOME SUPPLY SYSTEMS IN POLAND

The ever increasing degradation of water sources as well as the concomitant need of applying chemical disinfectants have directed the attention of scientists and engineers to the problem of long-term exposure of human organisms to water pollutants with health hazard potential. Considering the specific physicochemical properties of water, epidemiological studies or long-term experiments on animals are useless. For this reason, our knowledge of the potential mutagenicity of organic water pollutants is based primarily on bacterial screening tests, such as the UMU test or the Ames test. The need of unifying the investigations of the mutagenicity of water acted as a spur to DIN and ISO to attempt standardization of the two screening tests mentioned above. For the purpose of the present study, use was made of the Tube UMU test (which resembles the UMU microtest proposed by ISO) to evaluate the genotoxicity of water. The samples under test came from the waterworks chosen (which use different treatment methods and different types of water intake), from the water-pipe network, and from oligocenic wells. The present study substantiates the utility of the UMU test in evaluating routinely the genotoxicity of drinking water. Significant genotoxicity levels were detected in the majority of disinfected water samples, and they were found to vary according to the type of intake. More advanced treatment trains (for example, those involving carbon beds) bring about a substantial abatement of mutagenicity in drinking water. The genotoxicity of the disinfected water samples should be attributed to a group of non-volatile pollutants.

*National Institute of Hygiene, ul. Chocimska 24, 00-791 Warszawa, Poland.

ANDRZEJ K. BIŃ*, WŁODZIMIERZ MOŻARYN**

BROMATE PROBLEM – CURRENT STATE OF RESEARCH AND ADVANCES IN WATER TREATMENT TECHNOLOGIES

The paper provides a critical review of recent publications on how bromates form and how the available water treatment methods can minimize their concentrations. From this review it can be concluded that the molecular and radical mechanisms governing the reactions of bromine compounds with ozone in aquatic environment are quite well understood. They all evidence the complex character, as well as the potential influence of the process parameters involved on the extent of these reactions and the conversion of bromides into bromates. This finding holds particularly for the water matrix, which is treated with ozone or for the advanced oxidation processes, which are in use now. Many investigators concentrated on the problem of how to abate the bromate levels accounted for by the complex reactions of bromine compounds with oxidants (ozone, hydrogen peroxide, catalysts) as well as UV irradiation, and how to provide efficient removal of those pollutants from the water treated. In this context, the papers by the Dutch researchers and the study by VON GUNTEN et al. deserve particular attention. They show that it is possible to optimize the treatment process so as to meet the disinfection requirement, to remove the micropollutants (mainly pesticides) from the water, and to keep the concentration of bromine within the allowable range. The authors mentioned emphasize not only the potentiality for achieving good treatment effects when using hydrogen peroxide, but also some advantages resulting from the application of UV irradiation and catalytic processes (TiO_2, synergetic effects of iron and manganese removal).

*Faculty of Chemical and Process Engineering, Warsaw University of Technology, ul. Waryńskiego 1, 00-645 Warszawa, Poland.
**ELIMP, Ltd., ul. Cybernetyki 13, 02-677 Warszawa, Poland.

ANDRZEJ M. DZIUBEK*, JOLANTA MAĆKIEWICZ*

APPLICATION OF SURFACE COAGULATION TO INFILTRATION WATER TREATMENT

The quality of infiltration water was assessed and the effects of the treatment process, which involved coagulation in the rapid-filter bed were discussed. The optimum filtration rate was established and the treatment effects were related to the type of the coagulant and polyelectrolytes used. The experimental study substantiated the usefulness of the cation polyelectrolyte Magnafloc LT31 and the efficiency of polyelectrolyte-aided ferric chloride coagulation. In this way it was possible to reduce the coagulant dose without deteriorating the water treatment effects in the 24-hour filtration cycle.

*Institute of Environment Protection Engineering, Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland.

BEATA PACHOLEC*, JACEK WĄSOWSKI**, EWA DĄBROWSKA**, BERNARD KREKORA*, BOGDAN NOWAK*

ANALYZING THE YIELD OF THE INFILTRATION WELLS OF THE WARSAW WATERWORKS

Following statistical analysis of the data sets obtained in the timespan of 1990–1997, the technological effects of infiltration water treatment were estimated and related to water quality variations in the Vistula River. Consideration was also given to the problems emerging during operation of the infiltration water intakes, as well as to the requirements that must be met in order to enable a smooth operation of the drainage system. Particular attention was focused on the operation of the infiltration wells during low water in the winter of 1991 and during flood in the summer of 1997.

*Communal Waterworks and Sewage System for Warsaw, ul. Brukselska 21, 03-973 Warszawa, Poland.
**Institute of Water Supply and Hydroengineering, Warsaw University of Technology, ul. Nowowiejska 20, 00-665 Warszawa, Poland.

APOLINARY L. KOWAL*, JANUSZ PRZEWŁOCKI*, CELINA ŁOJEWSKA*

TREATMENT OF IMPOUNDMENT LAKE WATER FOR THE MUNICIPAL SUPPLY SYSTEM OF JELENIA GÓRA

Laboratory- and pilot-scale investigations were carried out on water samples from an impoundment lake (under construction) and from three creeks feeding the lake. Making use of the results obtained and taking into account the predicted composition of the impoundment lake water (which is likely to be of a mesotrophic character), the treatment train was established. It includes contact filtration and chlorine disinfection. Because of very low alkalinity, the water needs alkalization prior to the filtration process. Other treatment trains were also considered, but they were all found to be far less effective. Chlorine disinfection is recommended because of low organic matter concentration.

*Institute of Environment Protection, Branch of Wrocław, Wybrzeże Wyspiańskiego 39a, 50-370 Wrocław, Poland.

LESŁAW ZIĘBA*

ON THE NEW EU DIRECTIVE ABOUT DRINKING WATER QUALITY AND THE IMPLICATIONS OF THE NOVEL ISSUE FOR POTABLE WATER SUPPLIERS

The latest of the EU Directives (No. 09/83/EC of 25 Dec. 1998) about drinking water quality is analyzed in detail. Compared to the Directive of 1980 (No. 90/778/EEC), the recommendations for, and the demands made on the quality of drinking and household water have become more rigorous. In this context, the intended amendments to the Potable and Household Water Quality Act issued by the Minister of Health and Social Care in 1990 are discussed. The implications of the said issues for potable water suppliers in Poland are specified. There is an urgent need of amending relevant Polish regulations, which are in force now, thus allowing the water suppliers to implement advanced technologies or to retrofit the available systems.

*Communal Waterworks and Sewage System, Ltd., ul. Na Grobli 14/16, 50-421 Wrocław, Poland.

KAZIMIERZ BONETYŃSKI*, DARIUSZ KOWALSKI*, KAZIMIERZ STELMACH**

ON THE INADEQUACY OF THE IRON CONCENTRATION STANDARD FOR POTABLE WATER INCLUDED IN THE MINISTRY OF HEALTH AND SOCIAL CARE DIRECTIVE

In Poland, the quality parameters of potable and municipal water must comply with the Directive of May 4, 1990 issued by the Ministry of Health and Social Care. Although relevant regulations are met, analysis of tap water quality at draw-off points often reveals episodes of considerably exceeded admissible concentration values, especially those of iron compounds. This phenomenon should be attributed to the corrosive power of the material of which the pipes have been made, as well as to the high admissible concentration value for iron content in treated water. The objective of the study reported in this paper was to examine the contribution of fittings, pipes and pipelines to the recontamination of the tap water by iron compounds exemplified by a municipal pipeline chosen. The authors estimated the quantity of iron compounds coming from the corrosion of fittings, pipes and water network and analyzed the hydraulic loading of the housing-estate and transit pipelines. Consideration was also given to the problem of non-uniform distribution of iron compound concentrations at the chosen points of the water-pipe network under study. The factors contributing to the occurrence of exceeded iron compound concentrations at the draw-off points were determined. The authors suggested a number of preventive measures.

*Chair of Water Supply and Sewage Removal, Technical University of Lublin, ul. Nadbystrzycka 40, 20-618 Lublin, Poland.
**Chair of Engineering and Environmental Protection, Technical University of Lublin, ul. Nadbystrzycka 40, 20-618 Lublin, Poland.

ANDRZEJ GIERAK*, ROMAN LEBODA*

ANALYSIS OF POLLUTANTS FOUND IN MUNICIPAL WATER AND OF THOSE FORMING IN THE COURSE OF WATER DISINFECTION WITH OZONE

When the surface water to be treated contains bromides and ammonium salts, ozonation will stimulate the formation of bromates, nitrites and nitrates, which have been identified as potential cancerogenic

species. The admissible concentration of nitrates defined in Polish Standards is 10 g N/m^3 (which corresponds to ca. 44 g NO_3^-/m^3). In Germany, the admissible concentration of nitrites must not exceed 0.1 g N/m^3. In Poland, the admissible concentration of bromates has not been established yet. The maximal admissible concentrations of bromates in drinking water recommended by US EPA and WHO range between 10 and 50 mg BrO_3^-/m^3 Moreover, it is postulated that, in future, these levels should be decreased to 5 mg/m^3 as soon as appropriate methods have been developed to enable determination of such low bromate levels. The objective of the present study was to discuss the problems that have to be tackled when determining bromate and nitrate concentrations in municipal water by high-performance ion-exchange chromatography (IC-HPLC) or other techniques. Our investigations have shown that direct determinations of nitrates and bromates are feasible at concentrations of 2 g NO_3^-/m^3 and over 0.2 g BrO_3^-/m^3, respectively.

*Faculty of Chemistry, Maria Curie-Skłodowska University in Lublin, pl. Curie-Skłodowskiej 3, 20-031 Lublin, Poland.

MARIAN BŁAŻEJEWSKI*, ALINA PRUSS*

ASSESSING THE CONTRIBUTION OF THE ASSIMILATION PROCESS TO THE REMOVAL OF AMMONIA NITROGEN FROM AQUEOUS SOLUTIONS

Laboratory tests involving a physical model of a rapid filter and two filtration velocities showed that in the course of the nitrification process (which was run in the filter bed at gravitational water flow and a filtration velocity of 5 m/h) approximately 38% of the initial nitrogen load were converted into nitrate nitrogen, the remaining portion of nitrogen being built into bacterial cells. Of these, about 33% passed into the filtrate as organic nitrogen, and about 29% probably remained in the filter bed. At filtration velocity of 7.5 m/h, approximately 54% of the initial nitrogen converted into nitrate nitrogen. The remaining portion was fixed in bacterial cells (forming a biofilm) and converted into organic nitrogen. Total nitrogen measured in the effluent from the filter bed was higher than that in the influent water. Growing and ageing, the biofilm was easier torn off as a result of increased filtration velocity, thus contributing to a considerable rise in organic nitrogen concentration in the filtrate. The washing away of the biofilm either enhanced or inhibited the assimilation process. The proportion of nitrification and assimilation in the process of ammonia nitrogen removal was found to be 2:3 and approximately 1:1 at filtration velocity of 5 m/h and 7.5 m/h, respectively.

*Institute of Environmental Engineering, Poznań University of Technology, ul. Piotrowo 3a, 60-965 Poznań, Poland.

MARTA RAK*, MARIA ŚWIDERSKA-BRÓŻ*

COMPARING THE FLOCCULATING EFFICIENCY OF ALUM AND PAC

The coagulation process under test involved either aluminium sulphate (alum) or polyaluminium chloride (PAC) as flocculating agents. The flocculants differed in alkalinity, and PAC was subject to hydrolysis. The samples of model solutions and riverine water (the Odra and Oława Rivers) were coagulated. The flocculants were evaluated in terms of removal efficiency and contribution to the corrosivity of the effluent from the coagulation process. Comparative analysis of the two flocculants revealed the fol-

lowing: 1. The PAC coagulant was more effective in removing coloured matter. 2. Aluminium concentration persisting in the post-coagulation effluent was lower in the presence of PAC than when alum was used as flocculant. 3. The prehydrolized flocculant, i.e. PAC, did not affect the corrosive power of the effluent as much as alum.

*Institute of Environment Protection Engineering, Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland.

ANNA WOLBORSKA*, ROMAN ZARZYCKI*, BEATA MĘTLEWIAK*

RELATIONSHIP BETWEEN THE TYPE OF ALUMINIUM COAGULANT AND THE QUALITY OF TREATED WATER

It is a well-established fact that the conventional aluminium sulfate coagulant contributes largely to the aggressiveness of treated surface water. To abate this undesired effect of the coagulation process use is made of lime, which in turn affects the operation of rapid filters and sometimes seriously limits the application of activated carbon beds. The experiments reported in this paper were carried out with samples of raw water entering the Kalinko Water Treatment Plant. The objective of the experimental study was to test the usefulness of two prehydrolized coagulants of increased alkalinity – PAC and PAX. Their effectiveness was analyzed not only in terms of coloured matter, COD and turbidity removal (as compared to the effectiveness of the conventional alum coagulant), but also in terms of chemical stability of the water following coagulation. The results obtained allow the following generalization to be made: The quality of water with temporarily deteriorated parameters (e.g., that of flood water) can be upgraded by applying a coagulant which is "better" in economic and technological terms. Taking into account the efficiency of the treatment process, as well as the effect of coagulation on pH and alkalinity (both the parameters being of prime importance to the assessment of aggressiveness), the coagulating preparations PAX XL-1 and PAX XL-3 are better suited than aluminium sulphate for the treatment of such water.

*Chair of Environmental Engineering Systems, Technical University of Łódź, ul. Wólczańska 213, 90-924 Łódź, Poland.

TADEUSZ KOWALSKI*, DARIUSZ TURKIEWICZ*

THE EFFECT OF CALCIUM AND MAGNESIUM DOSES ON THE COURSE OF ALUM COAGULATION

The experiments involved riverine water samples (from the Odra and its tributary Oława). Prior to the coagulation process, the samples were treated with $CaCl_2$ (10 g Ca/m^3 and 20 g Ca/m^3) or $MgSO_4$ (6 g Mg/m^3 and 12 g Mg/m^3). It was found that when the Odra river water samples were coagulated with alum alone (100 g/m^3), the removal of COD averaged 30%. But when the coagulant was aided by pretreatment with either of the two title salts, the efficiency of COD removal approached 50%. For the OŁawa river water samples, the efficiency of COD removal was approximately 20% and 40%, respectively. The results of the experimental study show that the rise in the efficiency of organic matter removal due to the application of neutral salts ($CaCl_2$ or $MgSO_4$) should be attributed to the change in the physicochemical properties of the iron–humic acid complex in the riverine water, especially to the change in its ion-exchange capacity.

*Institute of Environment Protection Engineering, Wrocław University of Technology, Wybrzeże Wyspiańskiego 27, 50-370 Wrocław, Poland.

WALDEMAR BICZ*, MARTA KONIECZNA*, ANDRZEJ ZILBERT*

WATER TREATMENT WITH DYNASAND FILTERS: A CASE STUDY

The object under study is the Waterworks of KŁodzko which serves a population of about 30 thousand inhabitants. Until quite recently, the water delivered to the municipal supply system was not treated. For sanitary reasons it was disinfected with sodium hypochlorite alone. The local sanitary inspectorate raised no objections to water quality, as it met the bacteriological standards. Physicochemical analyses, however, revealed that manganese concentrations exceeded the admissible values and that there were frequent episodes of iron concentrations above the admissible level. Thus, in June 1998 a water treatment plant was started. The treatment train includes aeration, filtration and disinfection with sodium hypochlorite. Raw water is pumped from the intakes (wells) to the aerating tower. From there the water passes through reaction tanks and DynaSand rapid filters before it is sent to the clean-water-storage-tank and to the city network. For a more effective manganese removal, as well as for pH adjustment, the passing water should be treated with sodium hydroxide and potassium permanganate ahead of the reaction tanks. Washwater from the DynaSand filters is treated in an additional DynaSand filter and thereafter sent to an infiltration well in the vicinity of the treatment plant. Concentrated washwater is discharged to the municipal sewerage system. The water treatment plant has a capacity of 385 m^3/h, at a filtration velocity of 11 m/h. The manganese removal process runs without pH adjustment and $KMnO_4$ application.

*Communal Waterworks and Sewage System in Kłodzko, ul. Piastowska 14, 57-300 Kłodzko, Poland.

ZYGMUNT DĘBOWSKI*, BRONISŁAW NOWOK**

REGENERATION PARAMETERS OF THE ACTIVATED CARBONS APPLIED TO WATER TREATMENT IN THE DZIEĆKOWICE WATERWORKS

Three activated carbons (referred to as Carbon A, B and C, respectively) being a part of the water treatment train in the Dziećkowice Waterworks were tested. Regeneration was carried out in a laboratory furnace designed for that particular purpose. Each of the carbons tested (all of them being used as components of the filter bed) was regenerated in a different way although the parameters of the furnace remained unchanged. Thus, Carbon A showed better adsorptive properties after regeneration than when it was fresh, Carbon B became overreactivated, and Carbon C displayed optimal parameters.

*Institute of Environmental Engineering, Technical University of Częstochowa, ul. Dąbrowskiego 69, 42-200 Częstochowa, Poland.
**Upper Silesian Waterworks, ul. Wojewódzka 19, 40-024 Katowice, Poland.

KRZYSZTOF MATUSZEWSKI*, EWA BIEŃKOWSKA*, WŁODZIMIERZ MOŻARYN**

ASSESSING THE EFFICIENCY OF FULL-SCALE GAC FILTER BEDS OPERATED AT THE PODOLSZYCE WATERWORKS OF PŁOCK

The study covered the period of 1994–1998, and efficiency estimates were established using varying water quality parameters of choice. The first symptoms of GAC deactivation (decrease in biosorption

efficiency) were noticed in the third year of operation. By the end of the four-year period, there appeared the necessity of either regenerating the GAC bed or replacing it with a fresh one.

*Waterworks in Płock, Ltd., ul. Gradowskiego 10, 09-402 Płock, Poland.
**ELIMP, Ltd., ul. Cybernetyki 13, 02-677 Warszawa, Poland.

EUGENIUSZ LATAWIEC*, LESZEK DYDYCZ*, HENRYK PIĄTKIEWICZ**, BARBARA CHMIELARZ**, STANISŁAW FILIP**, KAZIMIERZ SUBCZAK**

A CONCEPT OF OZONE GENERATION AND THE EFFICIENCY OF PREOZONATION: A ONE-YEAR CASE STUDY

Preozonation of raw water was included into the treatment train of the Zwięczyca Waterworks, Rzeszów, in May 1998. The concept of producing ozone from oxygen was first implemented in Poland on that date. The implementation procedure was preceded by thorough economic considerations, based on comparisons with ozone production from atmospheric air. In the present paper, the concept of, and the device for, ozone generation from oxygen was described in detail. Consideration was also given to the problem of how preozonation affected the course of the other unit processes included in the treatment train and how it upgraded the quality of the treated water.

*ELIMP, Ltd., ul. Cybernetyki 13, 02-677 Warszawa, Poland.
**Communal Waterworks and Sewage System, Ltd., ul. Naruszewicza 18, 35-055 Rzeszów, Poland.

ANNA MOSSAKOWSKA*

DISINFECTION OF DRINKING WATER WITH CHLORINE DIOXIDE: A CASE STUDY

The object under study is the Waterworks of Warsaw. The water to be treated comes from the Vistula River. Recently use has been made of chlorine dioxide (generated in situ) for disinfection of drinking water. The paper describes in detail the on-site generation of ClO_2, the ClO_2 dosing system, and the quality of the water at the outlet from the plant and in the network. Two methods of disinfection were studied – one involved chlorine dioxide alone, the other one a ClO_2–Cl_2 mixture. The yield of THM formation was found to depend on the proportion of chlorine involved in the disinfection process. The criteria for the determination of the ClO_2 demand were proposed.

*Communal Waterworks and Sewage System for Warsaw, ul. Brukselska 21, 03-973 Warszawa, Poland.

WŁODZIMIERZ MOŻARYN*, BARBARA CHMIELARZ**

PILOT-PLANT INVESTIGATIONS OF THE EFFICIENCY OF FLOTATION IN THE COAGULATION OF RIVERINE WATER POLLUTANTS

Dissolved air flotation was carried out at the 2 m^3/h capacity pilot plant of the Zwięczyca Waterworks supplying municipal water (taken in from the Wisłok river) to the city of Rzeszów. The efficiency of the

process was compared with that of the conventional coagulation–sedimentation treatment train and was found to be almost equally high at far more moderate space demands.

*ELIMP, Ltd., ul. Cybernetyki 13, 02-677 Warszawa, Poland.
**Communal Waterworks and Sewage System, Ltd., ul. Naruszewicza 18, 35-055 Rzeszów, Poland.

JACEK WĄSOWSKI*, MAREK KULESZA**

OPTIMIZATION OF LACUSTRINE WATER TREATMENT BY INCLUDING DISSOLVED AIR FLOTATION INTO THE TREATMENT TRAIN

The technological studies reported in this paper were carried out at the pilot station of the Northern Water Treatment Plant in Wieliszew near Warsaw in the time span of 1996–1997. Water for municipal supply is uptaken from the nearby lake Zalew Zegrzyński. The primary objective of the study was to investigate how the inclusion of dissolved air flotation in the treatment train might upgrade the efficiency of coagulation and, consequently, of the treatment process. Thus, coagulation was carried out in a two-stage (I and II) system involving dissolved air flotation and a pulsator, respectively. Another objective was to choose the most effective flocculant type and dose from the three items tested: $Al_2(SO_4)_3$, $Fe_2(SO_4)_3$, and mixed coagulant. The best treatment effects were obtained when use was made of a two-stage coagulation process with DAF in I at the following proportion of the optimum flocculant dose: 70% at I and 30% at II. The process designed via the above route provided favourable conditions for the operation of rapid sand filters and yielded water of good quality before adsorption on GAC beds.

*Institute of Water Supply and Hydroengineering, Warsaw University of Technology, ul. Nowowiejska 20, 00-665 Warszawa, Poland.
**Communal Waterworks and Sewage System in Warsaw, Northern Water Supply System, ul. 600-lecia, 05-135 Wieliszew, Poland.

KRZYSZTOF WILMAŃSKI*

EFFICIENCY OF COAGULATION SLUDGE DEWATERING ON A FILTER PRESS

The sludges investigated were produced during alum coagulation and filter backwash. Samples were collected in two Upper-Silesian water treatment plants – the Waterworks of Strumień and the Waterworks of Będzin. The sludge samples were dewatered using a model filter press which made use of rubber membranes to remove residual water. The sludges coming from the two water treatment plants differed in volatile solids' content, which ranged from 14 to 20% dry wt. and from 40 to 60% dry wt. For the Strumień Waterworks and the Będzin Waterworks, respectively. The highest efficiency of dewatering was obtained by squeezing the sludge (with the use of membranes) in the final stage of the press operation cycle. The filtration cakes had a homogeneous structure. The efficiency of thickening and dewatering depended on the composition of the sludge. Thus, the samples collected at the Strumień Waterworks displayed a high mineral matter content. After thickening, water content amounted to 94% to approach 35% after dewatering on the filter press. The sludge samples coming from the Będzin Waterworks were characterized by a high volatile solids content and a water content of 98% and approximately 60% after thickening and dewatering, respectively. The dewatering process was successfully aided by cation or anion polyelectrolytes. The application of lime upgraded the quality of the filtrate from the dewatering process.

*Aquacomp, Ltd., ul. Słomińskiego 1, 00-204 Warszawa, Poland.

ŁUCJA FUKAS-PŁONKA*, KAROL KUŚ*, EWA ZIELEWICZ-MADEJ*

INVESTIGATING THE POTENTIALITY FOR THE DEWATERING AND DISPOSAL OF SLUDGES FROM FILTER WASH

The sludges produced in the course of the water treatment process, which involved rapid filtration, were investigated. Sludge samples were collected at the source of origin (a water treatment plant). The experiments yielded a dewatering to 30% of dry solids, which was equivalent to a 3-fold reduction of the sludge volume. The mechanical equipment suggested for sludge dewatering was a filter belt press, which enabled the sludge to be pumped directly from the settling tank. The sludge balance (which was established from the measured values of suspended solids concentrations in the washings as a function of time) served as a basis for the timetable of the settling tank cleanup. Since each settling tank will be cleaned up routinely twice a year, the use of a mobile filter belt press is postulated.

*Institute of Water and Sewage Engineering, Silesian Technical University, ul. Konarskiego 18, 44-101 Gliwice, Poland.

MIROSŁAWA SROKA*, MAREK KULESZA*

IMPROVING THE TREATMENT TECHNOLOGY FOR THE ZEGRZYŃSKI IMPOUNDMENT LAKE WATER TAKEN IN THE WATERWORKS OF WARSAW

Waterworks are to supply the users with quality water in quantities adequate for their needs. To achieve this goal it is necessary to develop new treatment technologies or modify (more or less) those used so far, because the pollution level in the recipients continues to increase, and so do the quality standards for potable water. Making use of the data sets provided by the Northern Waterworks, the quality of the water supplied to the city network and the efficiency of the treatment train were assessed. The results obtained showed that the treatment train needed improvement (especially at the stage of disinfection) in order to reduce THM precursors in the course of the treatment process and to minimize the potential of THM formation in the water. Thus, it is postulated that (1) the treatment train should be extended by the inclusion of secondary ozonation and adsorption on GAC beds, and (2) chlorine dioxide should be substituted for gaseous chlorine which has been used so far for water disinfection.

*Communal Waterworks and Sewage System, Ltd., ul. Naruszewicza 18, 35-055 Rzeszów, Poland.