тов, а также их количество в водопроводной воде г. Киева.

Ключевые слова: микромицеты, источники водоснабжения, этапы водоподготовки, водопроводная вода

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МІКРОМІЦЕТИ В ДЖЕРЕЛАХ ВОДОПОСТАЧАННЯ ТА ВОДОПРОВІДНІЙ ВОДІ

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Проведено оцінку наявності мікроскопічних грибів в джерелах водопостачання України. Визначено найбільш типові види мікроміцетів – представників родів *Penicillium*, *Aspergillus*, *Alternaria*, *Cladosporium.* Представлено результати мікологічного аналізу води різних етапів водопідготовки. Встановлено видову наявність мікроміцетів та їх кількість у водопровідній воді м. Києва.

Ключові слова: мікроміцети, джерела водопостачання, етапи водопідготовки, водопровідна вода.

MICROMYCETES IN SOURCES OF WATER SUPPLY AND TAP WATER

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The estimation of the presence of microscopic fungi in the sources of water-supply of Ukraine has been conducted. The most common types of micromycetes the species *Penicillium*, *Aspergillus*, *Alternaria*, *Cladosporium* are defined. The results of mycology analysis of water after different stages of its treatment are presented. The data on micromycetes species presence and their amount in Kiev's tap water is established.

Keywords: micromycetes, water supply sources, water treatment stages, tap water

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APPLICATION OF PERMANGANATE FOR MANGANESE REMOVAL AND DISINFECTION BY-PRODUCT CONTROL: A CASE STUDY

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Background & Objectives

General Pre-oxidation Chemicals

Potassium and sodium permanganate ($KMnO_4$, $NaMnO_4$) is used in the iron (Fe) and manganese (Mn) removal processes in both surface water and ground water systems that employ filtration. Permanganate oxidizes soluble iron and manganese to insoluble precipitates. The precipitates are removed from the water supply in the clarification and filtration processes.

Chlorine dioxide (ClO_2) is also an effective oxidant in water and wastewater treatment. Chlorine dioxide reacts rapidly with soluble forms of iron and manganese to form precipitates that can be removed through sedimentation and filtration.

However, the use of chlorine dioxide produces Disinfection By-Products (DBPs) including chlorite and chlorate. Chlorite and chlorate are produced in varying ratios as end products during chlorine dioxide treatment and subsequent degradation. Many governments currently require utilities using chlorine dioxide to monitor the water for chlorite. Some EU communities require utilities to test for chlorite levels to ensure their average does not exceed the limits. This limit vary by country e.g chlorite in mg/l in Germany 0,2; Sweden 0,7; England 0,5 (sum of ClO_2+$NaClO_2$+$NaClo_3$); Belgium 5; etc. In these situations, alternate technologies or combinations need to be evaluated to remain within discharge limits. This paper demonstrates the use of AQUOX® potassium permanganate was investigated as a pre-oxidant to remove Mn from the raw water and reduce the chlorine dioxide DBPs.

Permanganate Information

AQUOX® potassium permanganate or CARUSOL® sodium permanganate, when dissolved in water, imparts a pink to purple color depending on the final concentration. During the reaction, the disappearance of the characteristic pink color serves as an indicator that the reaction is taking place. The by-product of the permanganate ion reduction is manganese dioxide, an insoluble, relatively inert brown colored material that also aids the treatment process, When formed, manganese dioxide is capable of improving flocculation and the sorption of organic compounds responsible for the taste, odor, color, THM, and HAA problems, When the pink color changes completely to brown, the reaction is complete.

When using AQUOX®, two important operational controls must be maintained: (1) no "pink” color should be present in the finished water after filtration and (2) the insoluble manganese dioxide must be removed in the clarification steps (coagulation, flocculation, and filtration). Therefore, it is very important to conduct jar testing prior to feeding AQUOX® to determine the appropriate operational dose.

The Jato Water Treatment Plant

The Jato Water Treatment Plant is located near Palermo Italy and draws its water from Lake Poma. Water from the Lake normally has levels of manganese that require removal prior to distribution. The Jato Water Treatment Plant currently uses chlorine dioxide for manganese control. The facility has an average flow of 0,3 m^3/s with a maximum flow rate of 1,2 m^3/s. The plant uses an Accelator sedimentation as its primary solids removal process. When water enters to the rapid mix at the plant, chlorine dioxide and Alum [$Al_2(SO_4)^3$] are added and the water continues to the flocculation and sedimentation basins having a detention time of 1,5 to 10 hours depending of the water flow (e.g. 0,3 to 1,2 m^3/s). The water is then passed through sand filters that are backwashed every X hours. Prior to sand filtration, chlorine dioxide is again added for disinfection on top of the filters. With the current treatment using ClO_2, issues arise when high manganese levels are present in the raw water. Levels of chlorite, the common by-product from ClO_2 oxidation, can reach levels as high as 0,8 mg/L in the finished water. To eliminate this issue, AQUOX®

was investigated as a pre-oxidant to for manganese removal from the raw water thereby reducing the total chlorine dioxide total dosage and lowering the DBP residuals.

The objectives of this plant demonstration were:

Determine the AQUOX® demand in the raw water for the estimated detention time.

Optimize the dosage of AQUOX® for Mn removal.

Analyses of the Mn and chlorite (ClO_2^{-2}) residual in the finished water after using AQUOX® as a pre-oxidant.

Test Methods

Residual AQUOX®, iron, and manganese samples were filtered through a 0,22 pm pore size oxidant resistant filters before each analyses. Residual potassium permanganate were determined using Cams Analytical Method 103. This method uses standard DPD reagents and is based on the HACH Spectrophotometric Method 8021 for the determination of free chlorine. Manganese levels were analyzed using HACH PAN method 8149. Filtered manganese levels were tested only after the potassium permanganate oxidation reactions were complete. This eliminated any possible interference for the permanganate. A HACH DR890 Spectrophotometer was used for the above analyses. Jar testing was performed with 1.0-liter raw water samples.

Results

Determination of the AQUOX® Potassium Permanganate Value.

The 90 minute AQUOX® potassium permanganate demand value (PVt) of the water was 0,75 mg/L $KMnO_4$ at 11°C. The 120 minute AQUOX® potassium permanganate demand value (PVt) of the water was 0,85 mg/L $KMnO_4$ at 11°C. The 180 minute AQUOX® potassium permanganate demand value (PVt) of the water was approximately 0,95 mg/L $KMnO_4$ at 11°C. The PVt is defined as the calculated dose which would result in no permanganate residual at a given time, t. It may be determined by a linear regression of the permanganate residuals of the water at a given time plotted against dosage. The permanganate value is the dosage at which the residual vs. dosage line equals zero residual. Table 1 contains the experimental data and a plot of the data is given in Fig. 1. Note that due to the complete consumption of the 0,8 mg/L dose at 180 minutes, an estimate of the demand for this time had to be made.

AQUOX® Dose mg/l	Residual AQUOX® mg/l at T		Time = T, min
	90	120	180
0,5	0	0	0
0,8	**0,026**	**0,009**	**0**
1	0,12	0,103	0,048

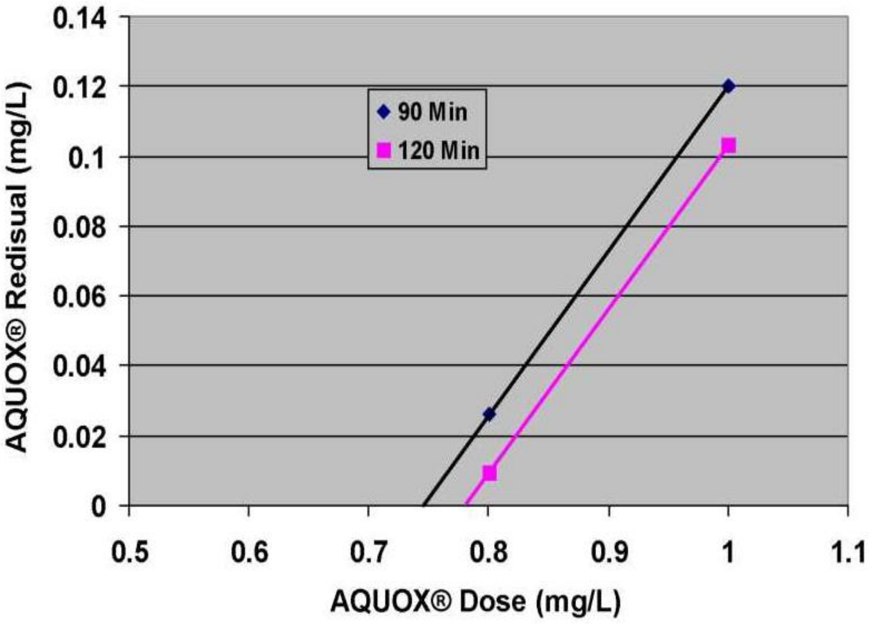

Fig. 1 – Determination of the AQUOX® Potassium Permanganate Value: Raw Water from Poma Lake

Trial Data

Manganese Removal

During the months of July and August, AQUOX® was applied at the raw water intake. Due to the high levels of manganese in the raw water, the AQUOX® dose was raised to 1,3 mg/L. This is higher than the original calculated demand but was required for effective manganese removal.

The results of the trial are presented in Fig. 2 and 3. As seen, AQUOX® was very effective at removing the manganese from the raw water. The average manganese level was reduced over 95 % from raw water concentrations.

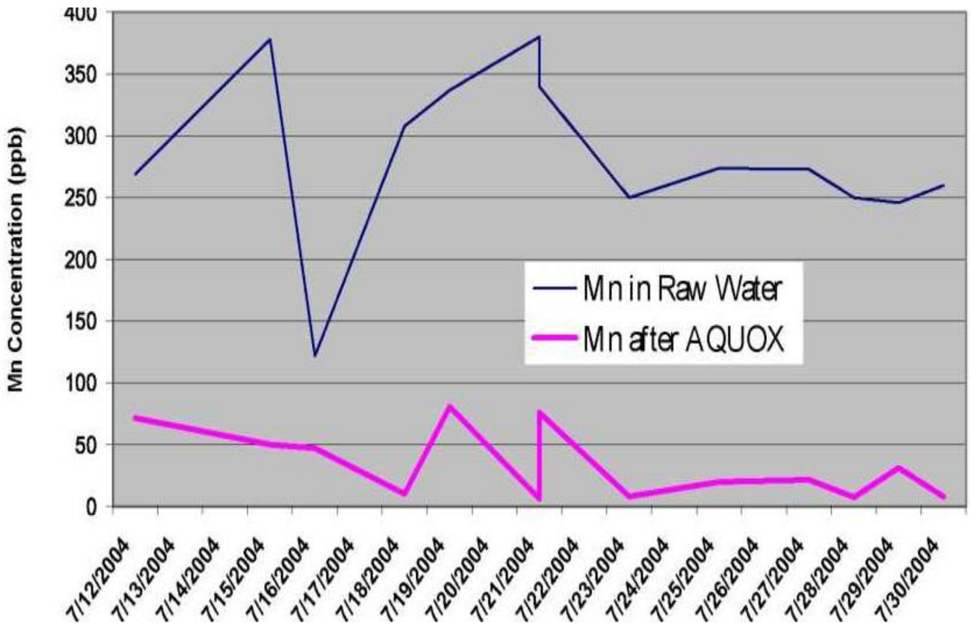

Fig. 2 – Poma Lake Raw Water: Removal of Mn with AQUOX®. Water Flow 0,1 m^3/s, July 2004

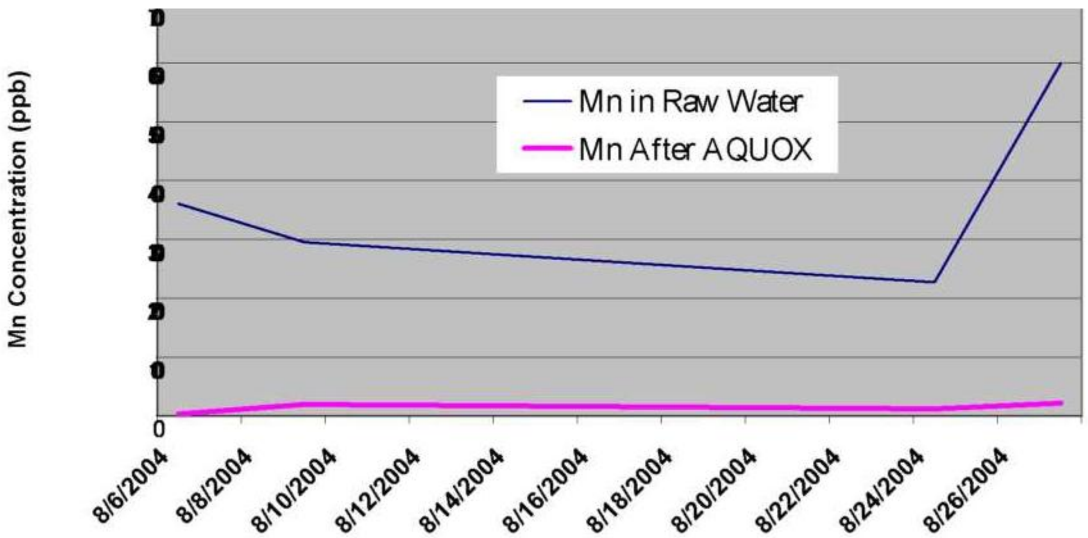

Fig. 3 – Poma Lake Raw Water: Removal of Mn with AQUOX®. Water Flow 0,3 m^3/s, August 2004

Chlorite Reduction

The objective of the trial was to eliminate pre-oxidation with ClO_2 to reduce the formation of chlorite. The addition of AQUOX® al lowed the elimination of pre-oxidation with ClO_2 resulting in lower chlorite residuals as shown in Fig. 4. As a result of pre-oxidation with AQUOX®, chlorite (ClO_2^{-2}) was reduced by 74 % from 1,41 to 0,36 ppm.

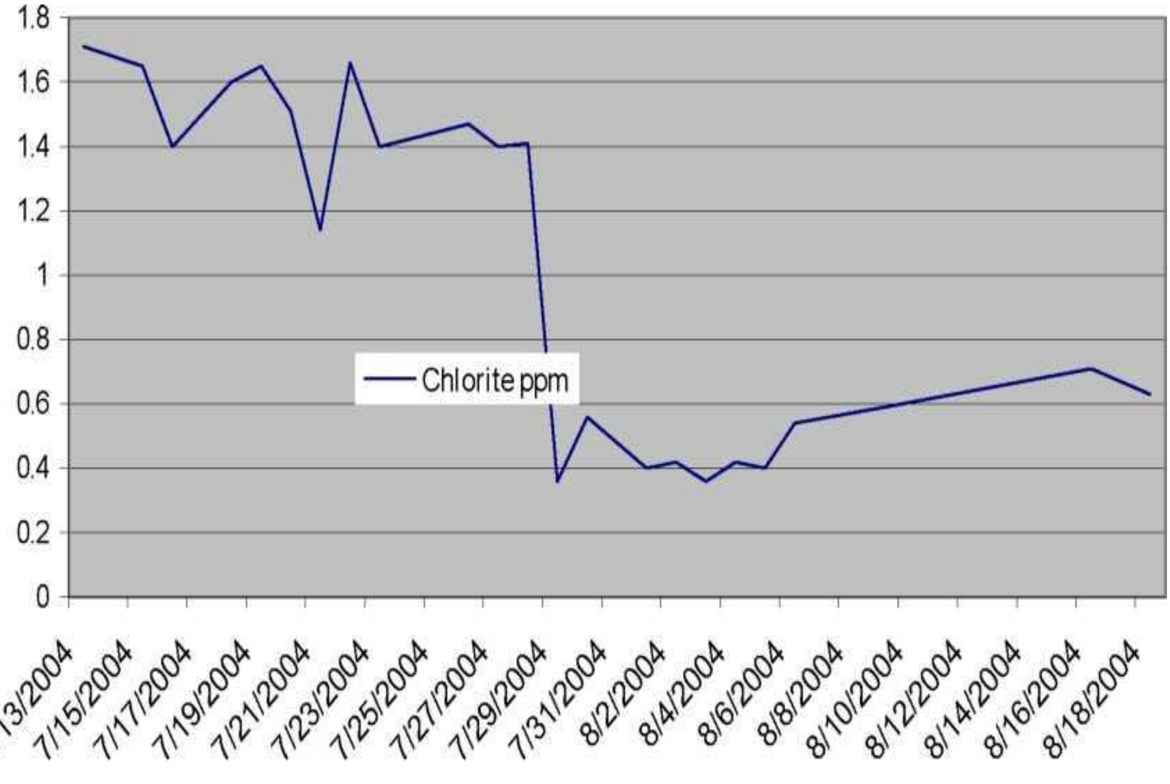

Fig. 4 – Poma Lake Finished Water: Reduction of Chlorite Residual with AQUOX®.
Water Flow 0,1 m^3/s, July 2004.

Conclusions

The available detention time for the AQUOX® oxidation reaction was estimated to be 120 minutes from the water leaving the rapid mix to the end of the Accelator at a flow of m^3/s.

Dosage of AQUOX® required for Mn removal was between 0,8 to 1,3 mg/l depending of the initial raw water manganese concentration.

Using AQUOX® as pre-oxidant, the Mn concentration from the raw water was lowered by 95,9 %. The chlorite (ClO_2^{-2}) derivates were reduced by 74 % (1,41 to 0,36 ppm).

AQUOX® is an excellent pre-oxidant for Fe, Mn removal and will effectively lower DBPs including chlorite, trihalomethanes and haloacetic acids [1 — 8].

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Appendix

Raw Water Analysis from Poma Lake, Palermo, Italy

Test on 06/08/04	**Metric Unit**	**Result**
Coliforme totat	UFC x 100 ml	320
Streptococchi fecali	UFC x 100 ml	9
Eschericchia Coli	UFC x 100 ml	1
Salmonella	UFC x 100 ml	None
Chloride	Mg/l Cl	83,7

Test on 06/08/04	**Metric Unit**	**Result**
Azoto Nitrico	Mg/l NO_3	6,2
Sulphate	Mg/l SO_4	147,7
Azoto Amonoalcale	Mg/l NH_4	0,2
Azoto Nitroso	Mg/l NO_2	0,07
Azoto Totale	Mg/l N	1,90
Orto-Phosfate	Mg/l P_2O_5	< 0,008
Conductibily	µS/cm 20°C	692
pH	7,73	
Sodium	Mg/l Na	71,4
Potasium	Mg/l K	5,3
Magnesium	Mg/l Mg	26,50
Calcium	Mg/l Ca	99,80
Anion tensoactive	Mg/l laurilsolfato	< 0,08
Color	Mg/l Pt-Co	7
TOC	Mg/l C	3,44

Summary

This paper will describe the application of permanganate as a pre-oxidant prior to final disinfection with ClO_2. The study was conducted at water treatment plant located in southern Italy that treats an average of 0,3 m^3/s with a maximum flow rate of 1,2 m^3/s. When water enters the rapid mix at the plant, chlorine dioxide and Alum ($Al_2(SO_4)^3$) were normally added and the process continues to the flocculation and sedimentation basins. Retention times can range from 1,5 to 10 hours depending of the water flow. Chlorine dioxide is added again for disinfection on top of the filters, In the finished water, the byproduct chlorite residual exceeds 0,8 mg/l and can reach 1,7 mg/L when high levels of Mn are in the raw water. As result, AQUOX® potassium permanganate was investigated as a pre-oxidant to remove Mn from the raw water and reduce the chlorine dioxide DBPs. Factors that will be discussed include feed systems; and permanganate optimization. The results will show a 96% removal efficiency for Mn and a reduction of 75% for residual chlorite when permanganate was used.

Keywords: permanganate, water treatment plant, removal efficiency.

Реферат

В данной статье описано применение перманганата, как предварительного окислителя, используемого до заключительной дезинфекции диоксидом хлора. Исследование проводилось на станции водоочистки в южной Италии, производительность которой составляет от 0,3 до 1,2 $м^3$/сек. Когда вода подвергается быстрому перемешиванию, обычно добавляют диоксид хлора и коагулянт ($Al_2(SO_4)^3$), что сопровождается выпадением осадка в резервуарах. Время ретенции может составить от 1,5 до 10 часов в зависимости от потока воды. Диоксид хлора, как дезинфектант, вводится перед фильтрами. В окончательно обработанной воде остаточная концентрация хлорита, как побочного продукта, превышает 0,8 мг/л и может достигать 1,7 мг/л, если в исходной воде Mn присутствует в значительных количествах. Перманганат калия (AQUOX®) исследован как предварительный окислитель, способный удалить Mn из исходной воды и уменьшить побочные продукты диоксида хлора. Полученные результаты показали 96 % эффективность удаления Mn и сокращение на 75 % остаточной концентрации хлорита при использовании перманганата.

Ключевые слова: перманганат, станция водоочистки, эффективность удаления

Реферат

У даній статті описано застосування перманганату як попереднього окиснювача, який використовували до заключної дезінфекції ClO_2. Дослідження проводилося на станції водоочищення в південній Італії, продуктивність якої становить від 0,3 до 1,2 м^3/сек. Коли вода швидко перемішується, додають діоксид хлору і коагулянт ($Al_2(SO_4)^3$), що супроводжується випаданням осаду в резервуарах. Час ретенції може скласти від 1,5 до 10 годин залежно від потоку води. Діоксид хлору, як дезинфектант, вводиться перед фільтрами. В остаточно обробленій воді залишкова концентрація хлориту, як побічного продукту, перевищує 0,8 мг/л і може досягати 1,7 мг/л, якщо у вихідній воді Mn є присутнім у значних кількостях. Перманганат калію (AQUOX®), досліджений як попередній окиснювач, здатний вилучити Mn з вихідної води і зменшити побічні продукти діоксиду хлору. Отримані результати показали 96 % ефективність видалення Mn і скорочення на 75 % залишкової концентрації хлориту при використанні перманганату.

Ключові слова: перманганат, станція водоочищення, ефективність видалення.

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УДК 504.42:628.3 (477.74-25)

ВПЛИВ СКИДУ СТІЧНОЇ КАНАЛІЗАЦІЙНОЇ ВОДИ В РАЙОНІ ПЛЯЖУ «АРКАДІЯ» НА МОРСЬКЕ СЕРЕДОВИЩЕ

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Державна екологічна інспекція Північно-Західного регіону Чорного моря, м. Одеса

Вступ

Географічне положення Північно-Західної частини Чорного моря характеризується значною шельфовою зоною, яка відчуває на собі потужний вплив стоку рік Дніпра, Дунаю, Дністра і Південного Бугу. Великий водозабірний басейн та річковий стік цих основних європейських рік формує понад 80% забруднення морського середовища.