

Lech Kos,
Karina Michalska,
Renata Żyła,
*Jan Perkowski

Textile Research Institute,
ul. Brzezińska 5/15, 92-103 Łódź, Poland,
E-mail: lkos@iw.lodz.pl

*Lodz University of Technology,
Institute of Applied Radiation Chemistry,
ul. Wróblewskiego 15, 93-590 Łódź, Poland,
E-mail: japerepi@mitr.p.lodz.pl

Effect of Formic Acid on Pollutant Decomposition in Textile Wastewater Subjected to Treatment by the Fenton Method

Abstract

The aim of this research was to determine the effect of formic acid on pollutant decomposition in textile wastewater subjected to treatment by the Fenton method. To estimate the effect of formic acid on treatment efficiency for different types of textile wastewater tested, COD reduction in mixtures of wastewater and formic acid was calculated. The values of COD calculated were then compared with COD values obtained experimentally during the oxidation of samples of wastewater-formic acid mixtures in the Fenton process. It was found that the presence of formic acid did not deteriorate the conditions of wastewater treatment in the Fenton process. Thus the presence of formic acid in textile wastewater is more advantageous than that of acetic acid.

Key words: formic acid, textile wastewater, chemical oxidation, Fenton method.

Introduction

The Fenton process is one of the simplest and cheapest methods to significantly reduce the concentration of pollutants in textile wastewater. It consists in non-selective and highly efficient oxidation of organic compounds by means of hydroxyl radicals produced in the chain process of hydrogen peroxide degradation in the presence of bivalent iron salts. The HO• hydroxyl radicals with high oxidizing potential are able to oxidise even the most resistant pollutants [1 - 9]. The run and efficiency of oxidation is determined by specific types of chemical compounds present in the textile wastewater. This refers, among others, to low-molecular compounds which on the one hand are a natural result of textile dyeing and finishing technology, but on the other one are intermediate or final products formed as a result of the oxidation of high-molecular compounds. The latter ones can be produced in quantities which may affect the run and mechanism of the oxidation reaction [10 - 12]. One such compound occurring in textile wastewater is formic acid.

While studying the results of pollutant oxidation in wastewater with the use of hydroxyl radicals, a significant decrease

in the concentration of total organic carbon in the wastewater with a simultaneous increase in the concentration of carboxylic acids was observed [13]. One of the main products was formic acid. The total organic carbon content in the oxidised wastewater generated by carboxylic acids being formed reached even 50% of the total value of TOC (Total Organic Carbon). During the oxidation processes 70% of organic compounds present in the wastewater was mineralised to CO₂, while 30% was transformed into carboxylic acids. Hence the presence of formic acid can affect significantly the oxidation processes which proceed in the wastewater. Our earlier studies on the effect of acetic acid on pollutant oxidation in textile wastewater by the Fenton method showed that this acid had a negative effect on pollutant decomposition [14]. In literature there are scarce and ambiguous data on the effect of low-molecular compounds on pollutant decomposition in wastewater in the Fenton process.

Japanese researchers [15] achieved 92% decomposition of formic acid in a Fenton reaction at an initial acid concentration of 1.1×10^{-2} mol/dm³. The dose of Fe⁺² ions applied was 2.8×10^{-4} mol/dm³, that of hydrogen peroxide 2.5×10^{-2} mol/dm³, pH 2, and the time of reaction was 30 minutes. Formic acid decomposition in water solutions was also investigated by Rossetti et al. [16]. The initial concentration of formic acid was 2×10^{-3} mol/dm³, and the ferrous sulfate doses were 1×10^{-3} mol/dm³ and 2.2×10^{-3} mol/dm³. The ratio of hydrogen peroxide to formic acid concentration was 3 : 1 and 6 : 7. The authors obtained 31% decomposition of formic acid at the ratio 3 : 1 and 43% decomposition at the ratio 6 : 7. The

increase in hydrogen peroxide dosage was advantageous from the point of view of acid decomposition efficiency.

The aim of the research was to verify the Fenton process efficiency in relation to water solutions of formic acid and real textile wastewater with different concentrations and compositions which contain formic acid.

Experimental methods

The objects of the studies were water solutions of formic acid and textile wastewater of different concentrations and compositions, including dyeing and laundry wastewater and concentrate from the nanofiltration process. Laundry wastewater was generated in the initial washing of polyester knitwear. In the washing process anionic detergent was applied. The pH of the wastewater was 7.2, COD (Chemical Oxygen Demand) 350 mg O₂/dm³ and the content of anionic detergents was 30 mg/dm³. The dyeing wastewater tested came from the dyeing of cotton knitwear with reactive dyes. The pH of this wastewater was 10.3, COD = 4170 mg O₂/dm³ and the content of chlorides was 2100 mg/dm³. The concentrate examined came from the process of nanofiltration of wastewater after cotton knitwear dyeing. The concentrate had pH = 10.3 and COD = 4930 mg O₂/dm³.

Concentrated formic acid (PPH POCh, Gliwice, Poland) at a concentration of 91.3% was used in the experiments. Fenton's reagent consisted of about 30% solution of hydrogen peroxide (PPH POCh, Gliwice, Poland) and FeSO₄·7H₂O as iron (II) salt.

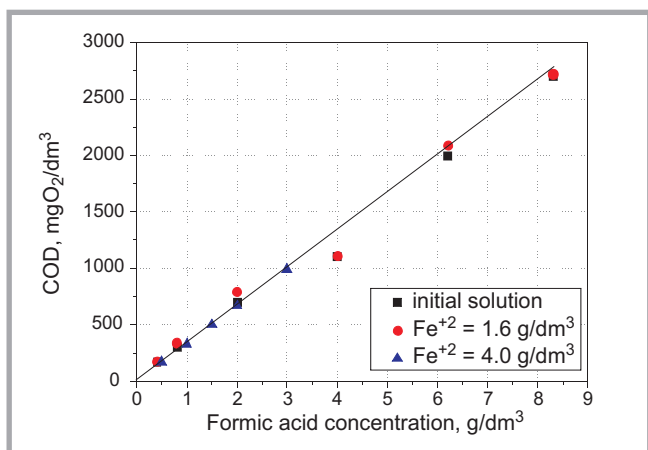


Figure 1. Dependence of COD on the concentrations of water solutions of formic acid co-precipitated by means of ferrous sulfate at concentrations 1.6 and 4.0 g/dm³ and not subjected to co-precipitation (initial solutions).

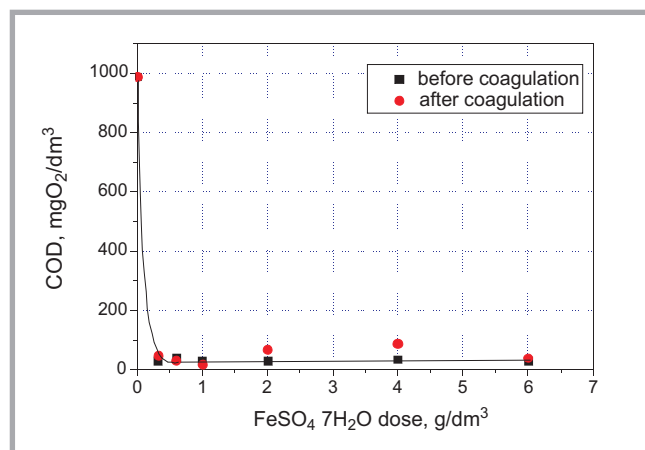


Figure 2. Value of COD in formic acid water solutions at the initial concentration - 3 g/dm³ after the Fenton process before and after coagulation depending on the dose of FeSO₄·7H₂O. The dose of hydrogen peroxide applied - 13.2 cm³/dm³ solution. Initial COD - 990 mg O₂/dm³.

In the case of water solutions, experiments were carried out at assumed formic acid concentrations without correcting the pH value. For instance, in a solution with acid concentration 3 g/dm³ the pH was 2.5. Next ferrous sulfate in a solid state was added to the solution, which was stirred until complete sulfate dissolution. Hydrogen peroxide was added drop-wise to the wastewater. Once H₂O₂ was instilled, the wastewater was stirred vigorously for 2 minutes and next slowly for 10 minutes. The solution was allowed to rest for 24 hours. Then the wastewater was neutralised with 10% solution of NaOH to a pH of around 11. After 24 hours the purified wastewater was decanted from the precipitate and filtered. COD was determined in the samples of water solutions of formic acid after treatment.

In the case of textile wastewater, its pH was reduced to 2.5 by means of 1 M solution of sulfuric acid. The procedure with the Fenton process was the same as in the case of water solutions of formic acid. COD was determined by Hach-Lange tests in the wastewater samples after treatment. The COD determination included the correction factor for chloride content in the wastewater.

■ Results and discussion

Co-precipitation of formic acid

In the Fenton process, besides the oxidation of formic acid by means of hydroxyl radicals, the process of *co-precipitation* induced by iron (II) hydroxide can also have an influence on the final COD reduction. To identify the contribution of

this phenomenon in the Fenton process, experiments with the *co-precipitation* of formic acid in the range of concentrations from 0.4 to 8.3 g/dm³ were carried out with two iron doses: 1.6 and 4.0 g FeSO₄·7H₂O/dm³ solution, the results of which are shown in **Figure 1**. The point of reference were COD values for different initial formic acid concentrations.

The results obtained show that there is no adsorption of formic acid particles on the flocs of iron (III) hydroxide formed during *co-precipitation*. In the whole range of acid concentrations the values of COD of the initial solutions overlap those obtained after *co-precipitation* at two different doses of iron (II) sulfate.

Oxidation of formic acid solutions in the Fenton reaction

Studies on the decomposition of formic acid by means of its oxidation in the Fenton process covered the determination of the effect of acid concentration, the concentration of iron (II) ions used, the quantity of hydrogen peroxide and pH on the efficiency of oxidation processes.

When investigating the effect of the concentration of Fe²⁺ ions on the efficiency of formic acid decomposition, FeSO₄·7H₂O was used in the amounts of 0.32, 0.6, 1.0, 2.0, 4.0 and 6.0 g/dm³ in the solution. The quantity of hydrogen peroxide applied was constant and amounted to 13.2 cm³/dm³ solution. The molar ratios of hydrogen peroxide to ferrous sulfate calculated were 4.5 : 1, 5.4 : 1, 8 : 1, 11 : 1, 16 : 1, 32 : 1 and 53 : 1, respectively. The formic acid concentration

applied was 3 g/dm³. The initial COD of the solution was 990 mg O₂/dm³. The values of COD obtained after the Fenton process before and after coagulation are shown in **Figure 2**.

As seen in **Figure 2**, the efficiency of formic acid decomposition measured by COD reduction at the applied doses of ferrous sulfate was constant within the measurement error. It was approximately 97%, so it was high.

The next stage of experiments involved testing the effect of the addition of hydrogen peroxide on the efficiency of formic acid oxidation in the Fenton process. The experiments were carried out with the use of hydrogen peroxide in the doses 13.2, 20, 30, 40, 50 and 60 cm³/dm³ solution. The ferrous sulfate dose applied was constant, amounting to 1 g/dm³ solution. The formic acid concentration was 3 g/dm³. The initial value of COD of the solution was 990 mg O₂/dm³. Values of COD obtained after the Fenton process prior to and after coagulation are shown in **Figure 3**.

The highest COD reduction, equal to ca. 98%, was achieved for hydrogen peroxide doses ranging from 20 to 60 cm³/dm³ solution. With an increase in the dose of H₂O₂ the COD reduction was maintained at a similar level.

A very important parameter which has an influence on the Fenton process is the pH of the solution. The efficiency of formic acid oxidation was investigated for the following pH values of the solution: 1.7, 2.5, 3.1, 3.6, 4.1 and 4.5. The pH of

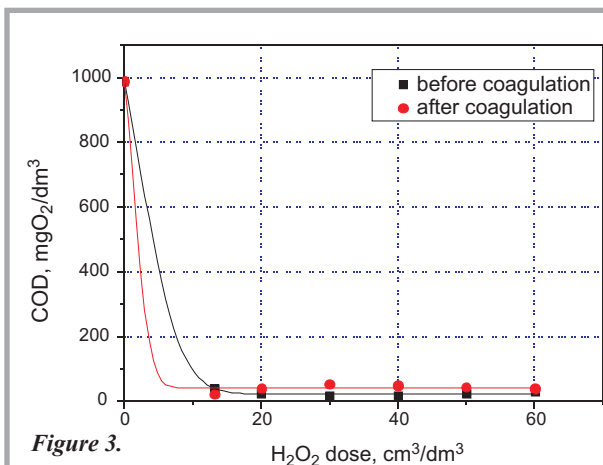


Figure 3.

H₂O₂ dose, cm³/dm³

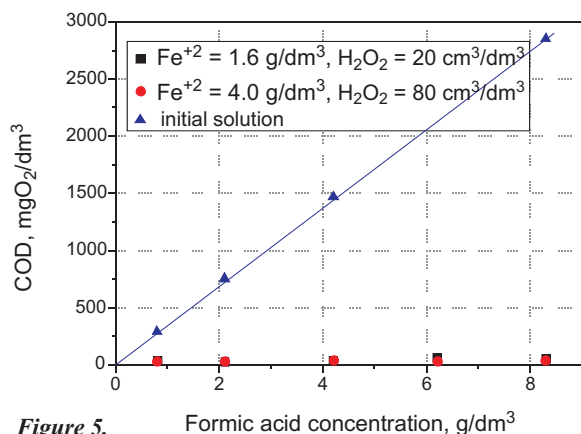


Figure 5.

Formic acid concentration, g/dm³

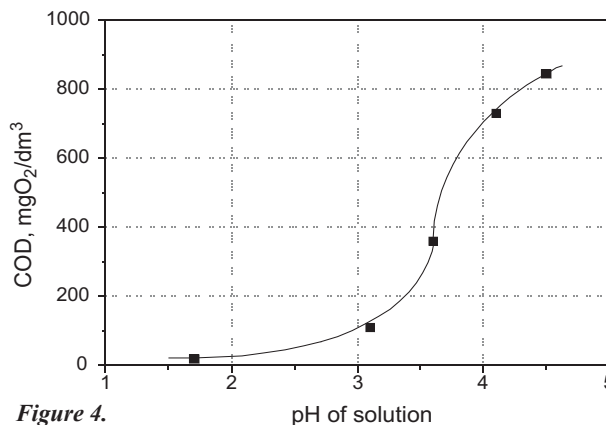


Figure 4.

pH of solution

Figure 3. Values of COD in water solutions of formic acid at initial concentration - 3 g/dm³ after the Fenton process (before and after coagulation) depending on the amount of H₂O₂ added. The FeSO₄·7H₂O dose applied - 1 g/dm³ solution. Initial COD of the solution - 990 mg O₂/dm³.

Figure 4. COD of water solutions of formic acid at concentration 3 g/dm³ after the Fenton process depending on the pH of the solution. The dose of iron (II) sulfate applied was 1 g/dm³, hydrogen peroxide - 40 cm³/dm³. Initial COD of the solution - 990 mg O₂/dm³.

Figure 5. Effect of formic acid concentration on the COD of the solutions before and after the Fenton process. The doses of ferrous sulfate and hydrogen peroxide were 1.6 g/dm³ and 20 cm³/dm³, respectively, and 4.0 g/dm³ and 80 cm³/dm³, respectively.

formic acid solutions was corrected by means of 1M sulfuric acid when acidification was required and by 10% solution of NaOH when alkalisation was necessary. The amount of ferrous sulfate added was constant and equal to 1 g/dm³ solution. The dose of hydrogen peroxide was also constant and amounted to 40 cm³/dm³ solution. The molar ratio of hydrogen peroxide to ferrous sulfate calculated was 1 : 100. Results of experiments are presented in **Figure 4**.

The results confirm that the Fenton process can be efficient only in a highly acidic environment [1, 2]. In the case of formic acid, in the reaction system applied the process should not be carried out at a pH exceeding 3 because then the oxidation efficiency decreases abruptly. The best results of COD reduction were obtained for a pH of around 2.

The next stage of experiments were investigations of the Fenton process efficiency for formic acid solutions at different initial concentrations ranging from 0.8 g/dm³ to 8.3 g/dm³. Experiments were made for two different doses of the reagents, namely ferrous sulfate dose 1.6 g/dm³ and H₂O₂ = 20 cm³/dm³,

and ferrous sulfate dose 4.0 g/dm³ and H₂O₂ = 80 cm³/dm³. **Figure 5** shows the results obtained. Additionally the diagram shows initial values of COD for formic acid solutions, which facilitates estimation of the process efficiency.

Formic acid decomposition in the Fenton process was very efficient in the whole range of concentrations tested, from 0.8 to 8.3 g/dm³. The final values of COD were in the range from 30 to 50 mg O₂/dm³, with the initial value being 2850 mg O₂/dm³ for the most concentrated solution. With such good results of the decomposition it was unnecessary to use a double dose of ferrous sulfate and to increase the amount of hydrogen peroxide four times. The process is very efficient in a broad range of formic acid concentrations, as well as being fast and not requiring big initial doses of the reagents.

In the Fenton process 97% COD reduction was obtained at the initial formic acid concentration - 6.5×10⁻² mol/dm³, dose of Fe⁺² ions - 1.2×10⁻² mol/dm³ and hydrogen peroxide - 3.55×10⁻⁴ mol/dm³. For comparison, Japanese researchers [15] achieved 92% decomposition of formic acid in the Fenton process at an initial

acid concentration of 1.1×10⁻² mol/dm³, dose of Fe⁺² ions 2.8×10⁻⁴ mol/dm³ and hydrogen peroxide 2.5×10⁻² mol/dm³. Italian researchers [16] obtained 31% decomposition of formic acid at an initial concentration of 2×10⁻³ mol/dm³, and in the Fenton process with the use of a dose of Fe⁺² ions of 5×10⁻⁴ mol/dm³ and hydrogen peroxide 6×10⁻³ mol/dm³.

Effect of formic acid on pollutant decomposition in textile wastewater

The effect of formic acid on pollutant decomposition was investigated for three types of real textile wastewater with different initial COD, ranging from 350 to 4930 mg O₂/dm³.

To the least concentrated laundry wastewater with an initial COD of 350 mg O₂/dm³ formic acid was added in doses of 0.5, 1.0, 1, 2.0 and 3.9 g/dm³ wastewater. The dose of FeSO₄·7H₂O applied was constant and amounted to 1.6 g/dm³ wastewater. The hydrogen peroxide dose was also constant and equal to 20 cm³/dm³ wastewater. **Figure 6** shows values of

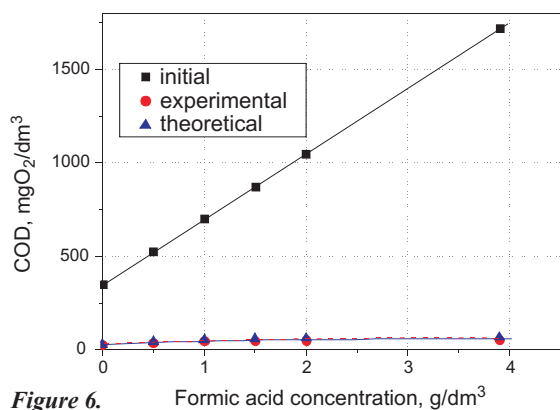


Figure 6. Effect of added formic acid on COD of laundry wastewater before and after the Fenton process. Dose of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O} - 1.6 \text{ g/dm}^3$ & $\text{H}_2\text{O}_2 - 20 \text{ cm}^3/\text{dm}^3$ wastewater. For comparison, theoretical COD values were given under the assumption of the additivity of the decomposition of formic acid – laundry wastewater mixture.

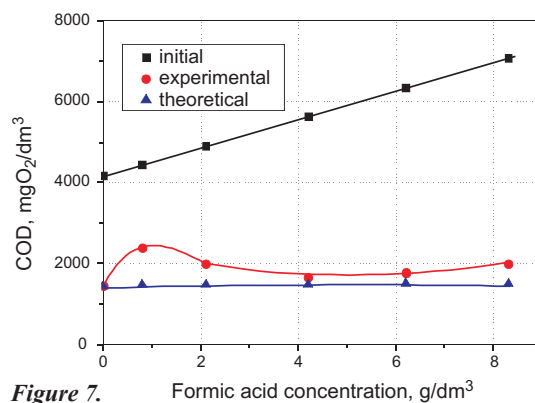


Figure 7. Effect of formic acid dose on the COD of the dyeing wastewater before and after treatment by the Fenton process. The amount of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O} - 1.6 \text{ g/dm}^3$, and wastewater - $\text{H}_2\text{O}_2 - 20 \text{ cm}^3/\text{dm}^3$. For comparison, theoretically determined COD reduction was presented assuming the additivity of the decomposition of the formic acid – dyeing wastewater mixture.

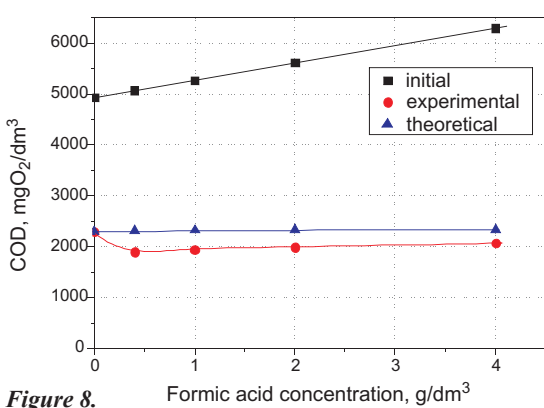


Figure 8. Effect of formic acid dose on the COD of the concentrate before and after the Fenton process. The dose of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O} - 1.6 \text{ g/dm}^3$, and that of $\text{H}_2\text{O}_2 - 20 \text{ cm}^3/\text{dm}^3$ wastewater. For comparison, theoretically calculated values of COD reduction under the assumption of the additivity of formic acid – concentrate decomposition are presented.

COD of the wastewater prior to and after treatment by the Fenton method.

It follows from the diagrams that the initial COD of laundry wastewater mixed with formic acid changed linearly with an increase in acid concentration. The values of COD after treatment by the Fenton method were practically constant. The degrees of COD reduction ranged from 93 to 97%. For comparison, the diagram also shows calculated theoretical values of COD in the wastewater after the Fenton process. The calculations are based on the results of COD reduction obtained in the Fenton process for single components, i.e. wastewater and formic acid solutions of specified concentration under the assumption of additivity. Practically, ideal overlapping of the theoretically and experimentally determined curves provides evidence of the lack of any effect of formic acid on the efficiency of pollutant decomposition in laundry wastewater in the range of concentrations tested.

In the case of dyeing wastewater with an initial COD of $4170 \text{ mg O}_2/\text{dm}^3$, formic acid was added in the doses 0.8, 2.1, 4.2, 6.2 and $8.3 \text{ cm}^3/\text{dm}^3$ wastewater. Constant doses of ferrous sulfate – 1.6 g/dm^3

and hydrogen peroxide – $20 \text{ cm}^3/\text{dm}^3$ wastewater were used. Figure 7 shows the values of COD obtained in the wastewater before and after treatment.

With an increase of formic acid concentration in the wastewater, a significant linear increase in COD occurred. After treatment by the Fenton method the values of COD were remarkably reduced in the range from 47% to 82%. Purification of the wastewater was worse at a lower formic acid concentration, i.e. at concentrations of 0.8 and 2.1 g/dm^3 COD decreased by 47 and 60%, respectively. At higher acid concentrations the percent of COD reduction was approximately constant and equal to about 72%.

Additionally, for comparison, Figure 7 shows calculated theoretical values of COD in wastewater subjected to the Fenton process. The calculations are based on the results of COD reduction obtained in the Fenton process for single components, i.e. wastewater and formic acid solutions of specified concentration under the assumption of additivity. The theoretical COD values calculated after the Fenton process for the dyeing wastewater – formic acid mixture are practi-

cally constant and only slightly lower, up to 6%, than the experimental values. An exception is the sample in which the initial acid concentration was 0.8 g/dm^3 , where the difference was higher, amounting to 18%. These relations may suggest a slightly negative effect of formic acid on pollutant decomposition in the dyeing wastewater.

The last sample tested was a concentrate produced during the nanofiltration of wastewater coming from the process of cotton knitwear dyeing. Its initial COD was $4930 \text{ mg O}_2/\text{dm}^3$. In this case formic acid was added in the amounts of 0.4, 1, 2 and $4 \text{ cm}^3/\text{dm}^3$ wastewater. The dose of $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ applied was constant and equal to 4 g/dm^3 wastewater. Similarly the hydrogen peroxide dose was also constant, amounting to $80 \text{ cm}^3/\text{dm}^3$ wastewater. The values of COD obtained in the wastewater before and after treatment by the Fenton method are shown in Figure 8. In the case of the concentrate the value of COD decreased after the Fenton process to about $2000 \text{ mg O}_2/\text{dm}^3$ in the entire range of formic acid concentrations. For comparison, Figure 8 shows that the theoretically calculated COD assuming additivity, after the Fen-

ton process, under the assumption that the independence of the concentrate and formic acid decomposition is bigger than the experimental data. The relations obtained suggest a slightly positive effect of formic acid on the concentrate decomposition.

Conclusions

Formic acid was very well decomposed in the Fenton process. No effect of the acid concentration on final COD reduction in the wastewater was found in the range of formic acid concentrations tested. A similar relation was observed while testing the effect of the amount of iron (II) dose on formic acid decomposition. In the case of hydrogen peroxide it was reported that this dose had an influence on COD reduction. Hydrogen peroxide should be added in the amount sufficient to carry out the process. An increase in the amount of H₂O₂ above the optimum dose did not enhance the decomposition. The Fenton process should be carried out in an acidic environment at a pH of around 2. The presence of formic acid in the textile wastewater tested had no significant effect on pollutant decomposition. Depending on the wastewater type, either a slight increase or decrease in oxidation efficiency or a similar reduction in pollutant concentration was observed in the case of the presence and absence of formic acid in the wastewater. Thus the presence of formic acid in the wastewater is more advantageous than that of acetic acid. In the latter case our investigations revealed a clearly negative effect of the presence of acetic acid on the decomposition of pollutants contained in textile wastewater [14]. From an ecological point of view it is recommended to replace acetic acid by formic in all technological processes wherever possible.

References

- Papadopoulos AE, Fatta D, Loizidou M. Development and Optimization of Dark Fenton Oxidation for the Treatment of Textile Wastewaters with High Organic Load. *Journal of Hazardous Materials* 2007; 146: 558-563.
- Kušić H, Bižić A, Koprivanac N. Fenton Type Processes for Minimization of Organic Content in Coloured Wastewater; Part I: Processes Optimization. *Dyes and Pigments* 2007; 74: 380-387.
- Perkowski J, Kos L, Ledakowicz S. Oczyszczanie ścieków włókienniczych nadtlenkiem wodoru w połączeniu z jonami

żelaza. *Przegląd Włókienniczy* 1998; 1: 26-29.

- Ledakowicz S, Maciejewska R, Gębicka L, Perkowski J. Kinetics of the decolorization by Fenton's reagent. *Ozone, Science & Engineering* 2000; 22: 195-205.
- Kos L, Michalska K, Perkowski J. Treatment of Textile Wastewater by Fenton Method. *Fibres & Textiles in Eastern Europe* 2010; 81:105-109.
- Perkowski J, Józwiak W, Kos L, Stajszczyk P. Application of Fenton's Reagent in Detergent Separation in Highly Concentrated Water Solutions. *Fibres & Textiles in Eastern Europe* 2006; 5: 114-119.
- Modirshahla N, Behnajady M, Ghanbary F. Decolourisation and Mineralization of C.I. Acid Red 23 by Fenton and Photo-Fenton Processes. *Dyes and Pigments* 2007; 73: 305-310.
- Wang S. A Comparative Study of Fenton and Fenton-like Reaction Kinetics in Decolourisation of Wastewater. *Dyes and Pigments* 2008; 76: 714-720.
- Xiang-Juan M, Hui-Long X. Treatment of Water-Based Printing Ink Wastewater by Fenton Process Combined With Coagulation. *Journal of Hazardous Materials* 2009; 162: 386-390.
- Ma J, Ma W, Song W, Chen C, Tang Y, Zhao J, Huang Y, Xu Y, Zang L. Fenton Degradation of Organic Pollutants in the Presence of Low-Molecular-Weight Organic Acids: Cooperative Effect of Quinone and Visible Light. *Environ. Sci. Technol.* 2006; 40: 618-624.
- Centi G, Perathoner S, Torre T, Verduna MG. Catalytic Wet Oxidation with H₂O₂ of Carboxylic Acids on Homogeneous and Heterogeneous Fenton-Type Catalysts. *Catal. Today* 2000; 55: 61.
- Abd El-Raady, Nakajima T. Effect of UV Radiation on the Removal of Carboxylic Acids from Water by H₂O₂ and O₃ in the Presence of Metallic Ions. *Ozone Science & Engineering* 2006; 28: 53-58.
- Mizuno T, Tsuno H, Yamada H, Takeshima D. Removal Characteristics of Organic Pollutants in Sewage Treatment by a Pre-Coagulation, Ozonation and Ozone/Hydrogen Peroxide Process. *Ozone Science & Engineering* 2008; 30: 263-274.
- Kos L, Michalska K, Żyła R, Perkowski J. The Effect of Acetic Acid on Pollutant Decomposition in Textile Wastewater Treated by Fenton Method. *Environment Protection Engineering* (in press).
- Abd El-Raady AA, Nakajima T. Effect of UV Radiation on the Removal of Carboxylic Acids from Water by H₂O₂ and O₃ in the Presence of Metallic Ions. *Ozone Science & Engineering* 2006; 28: 53-58.
- Rossetti GH, Albizzati ED, Alfamo OM. Decomposition of Formic Acid in a Water Solution Employing the Photo-Fenton Reaction. *Ind. Eng. Chem. Res.* 2002; 41: 1436-1444.

Received 04.11.2011 Reviewed 06.06.2013



Institute of Biopolymers
and Chemical Fibres

Multifilament Chitosan Yarn

The Institute of Biopolymers and Chemical Fibres is in possession of the know-how and equipment to start the production of continuous chitosan fibres on an extended lab scale. The Institute is highly experienced in the wet – spinning of polysaccharides, especially chitosan. The Fibres from Natural Polymers department, run by Dr Dariusz Wawro, has elaborated a proprietary environmentally-friendly method of producing continuous chitosan fibres with bobbins wound on in a form suitable for textile processing and medical application.



Multifilament chitosan yarn

We are ready, in cooperation with our customers, to conduct investigations aimed at the preparation of staple and continuous chitosan fibres tailored to specific needs in preparing non-woven and knit fabrics.

We presently offer a number of chitosan yarns with a variety of mechanical properties, and with single filaments in the range of 3.0 to 6.0 dtex.

The fibres offer new potential uses in medical products like dressing, implants and cell growth media.

For more information please contact:
Dariusz Wawro Ph.D., D. Sc., Eng
Instytut Biopolimerów i Włókien Chemicznych
ul. Skłodowskiej-Curie 19/27;
90-570 Łódź, Poland;
Phone: (48-42) 638-03-68, Fax: (48-42) 637-65-01
E-mail: dariusz.wawro@ibwch.lodz.pl



biobased materials

24 and 25 June 2014, Stuttgart/Fellbach



Biobased materials - 10th Congress for Biobased Materials, Natural Fibres and Wood Plastic Composites

24.06.2014 - 25.06.2014, Stuttgart-Fellbach, Germany

“Biobased Materials” continue to grow in importance globally in a wide variety of industrial sectors, and not only because of reasons associated with sustainability. The primary reason are the technical benefits of these materials. The potential for new products and new applications based on existing and new materials is far from being exhausted.

For the 10th time, the **Congress for Biobased Materials, Natural Fibres and Wood Plastic Composites (WPC)** provides a platform for industrial researchers, engineers and academics to present, exchange and discuss the latest developments, trends in innovations as well as strategic questions.

The Congress, which was initiated 1998 in Kassel, Germany, has helped to drive the expansion of applications of this group of materials. Considering the advancements and future trends, the Congress has expanded the focus from WPC to biobased composites and bioplastics and to renewable materials.

Over the years the Congress has attracted a tremendous number of participants (in the recent years from 40 countries), which makes it one of the leading events in Europe.

Topics

- Biological, biobased materials: bioplastics and biocomposites
- Natural and cellulose fibre-reinforced and innovative plastic composites
- Innovative processing and manufacturing methods for said materials and composites
- Additives and fillers for biobased materials and composites
- Innovative applications, for instance, in the furniture, construction, packaging, sporting goods, aircraft and automotive industries

Congress Coordinators

- Prof. Dr Alexander Bismarck, Universität Wien, Austria and Imperial College London, UK
- Prof. Dr Andrzej K. Błędzki, West Pomeranian University of Technology, Poland
- Dr Christoph Burgstaller, Transfercenter für Kunststofftechnik GmbH, Austria
- Prof. Dr Jörg Müssig, Hochschule Bremen BIONIK, Germany
- Dr Volker E. Sperber, Industrie Consultant, Germany
- Prof. Dr Rupert Wimmer, Universität für Bodenkultur Wien, Austria

Call for Papers just started - do not miss the opportunity to submit your abstract!

Conference fee

Regular fee	before 11 May 2014	after
Spacial rate for subscribes of 'Kunststoffe' and 'Kunststoffe International'	920 EUR	990 EUR
University staff	828 EUR	891 EUR
Speaker / Poster exhibit	395 EUR	475 EUR
		250 EUR

For more information please contact:

Lucia Femerling
 tel: +49 (0)89 99830-674
 fax: +49 (0)89 99830-157

e-mail: tagungen@hanser.de

www.biobased-materials.com



AACHEN DRESDEN
INTERNATIONAL TEXTILE CONFERENCE

Dresden, November 27-28, 2014

addressing experts in the fields of

Textile Chemistry, Finishing & Functionalization and
Textile Machinery, Manufacturing & Composites with

Plenary Lectures and **Special Symposia** on

➤ **Composites**

High-performance materials
2D and 3D textile constructions
Textile machine technology, special machine technology
Processing and preforming technologies
Modelling and simulation
Automated composite manufacturing
Applications (machinery, automotive, wind generators, aviation, ...)

➤ **Protective Textiles**

New materials
Sensor systems and actuating elements
Personal and property protection
Testing, standardization, certification

➤ **Textile Construction with Membranes and Textile-reinforced Concrete**

Construction and processing
Modelling and simulation
Applications

➤ **Chemistry for Composites, Protective Textiles, and Textile Construction**

Development and modification of polymers
Functionalization and coating
Surface and interface design, breaking behavior, characterization

➤ **Transfer Session „From Idea to Practice“**

Presentation of innovations (e.g. products, technologies, methods) successfully transferred from research cooperations (particularly IGF/ZIM, but also BMBF/EU/...) to industrial applications

Deadline Call for Papers: January 31, 2014

Contact for 2014: Annett Dörfel
Institute of Textile Machinery and High Performance
Material Technology at TU Dresden
annett.doerfel@tu-dresden.de; Tel.: +49 (0)351 463 39321

Further Information:
www.aachen-dresden-itc.de

ANNOUNCEMENT 2014 - Partner Country: South Korea