6th EURASIA WASTE MANAGEMENT SYMPOSIUM

24-26 OCTOBER 2022 ISTANBUL TURKEY

EURASIA WASTE MANAGEMENT SYMPOSIUM • 2022 •

EURASIA 2022

Editors

Prof. Dr. Ahmet DEMİR

Prof. Dr. Mehmet Sinan BİLGİLİ

PROCEEDINGS

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Conference Chair(s)

Prof. Dr. Ahmet Demir (Yildiz Technical University, Istanbul, Turkey)

Prof. Dr. Mehmet Sinan Bilgili (Yildiz Technical University, Istanbul, Turkey)

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PREFACE

On behalf of the organizing committee, I would like to welcome all participants to the 6th EurAsia Waste Management Symposium (EWMS) 2022 in Istanbul, Turkey. The symposium is jointly organized by Yildiz Technical University Environmental Engineering Department, ISTAC Inc., and International Waste Working Group, and supported by the Ministry of Environment and Urbanization. It is my pleasure to thank to all these organizations for their collaboration.

Our life and professional activities have recently been affected by Covid-19 pandemic that expands across the globe. Unfortunately, scientific symposiums are also affected by this global issue. Believing in the importance of these academic meetings, Eurasia 2022 Waste Management Symposium has moved to be both in-person and virtual implemented, as well.

Waste Management is currently the most common problem for both developed and developing countries. Because of increased environmental awareness, the impact of waste management and disposal activities on environment has turn into a very important issue. Thus, knowledge on the sustainable waste management, public relation, design and operation of disposal facilities, process and emissions, monitoring, and other environmental aspects are of high importance.

Sustainability, can be summarized as a system that protects our natural resources, reduces energy consumption and protects the environment. In the linear economy model, which has been applied for a long time, the negative effects of take-make-dispose applications have started to be seen on a regional and global scale. In this economy model, waste is considered as an undesirable output that needs to be disposed of, resources are used intensively, waste occurs not only in the consumption phase but also in the production phase. The transition to a new economic model has become inevitable, as resource consumption occurs faster than resource renewal. There is no doubt that the economic model that takes into account the needs of future generations by minimizing the negative effects on natural resources and the environment is the circular economy model.

In parallel with the developments in the world on circular economy, studies in Turkey have increased exponentially in recent years. Important steps have been taken by our Ministry of Environment, Urbanization and Climate Change regarding recycling, which is one of the important points of the circular economy, and the most important one is undoubtedly the "Zero Waste" Project launched in 2017. Yıldız Technical University, one of the most established universities in Turkey, has also succeeded in being the first university to receive a "Zero Waste" certificate, with its studies carried out within the scope of sustainability and zero waste practices.

EurAsia Waste Management Symposium is organized for the sixth time in our university joining distinguished colleagues who come from different countries and from different cities of Turkey to share their knowledge and experience. EWMS has been the premier symposium for the presentations of technological advances and research results in the field of waste management.

As before, the objective of the symposium is to give researchers, engineers and students an opportunity to get together for the dissemination of the international state-of-the-art and recent advances in the field of waste management and to enhance future collaborative research activities between scientists from Eurasia region as well as from other countries. The participants will share their knowledge of the latest progress, breakthroughs and exchange their views on possible solutions for various issues related to waste management.

The program includes 6 keynotes and 1 plenary on a range of important and current topics, 18 parallel sessions for oral presentation and a poster session. The invited lectures were delivered by well-known experts in the field (Prof. Dr. Raffaello Cossu, Prof. Dr. Sadhan K. Ghosh, Prof. Dr. Sanhya Babel, Prof. Dr. Dezhen Chen, Prof. Dr. Michael Nelles, Prof. Dr. Ian D. Williams).

Through the symposium, 132 presentations will be discussed in various topics such as waste management and zero waste strategies, electronic waste management, plastic waste and microplastics, hazardous and industrial waste management, construction and demolition waste management, processing of organic waste fractions, landfilling, collection, transportation and characterization of waste, new green deal in waste management, waste-to-energy, thermal technologies, treatment and disposal of sewage sludge, material recovery from incineration ashes ,etc.

I definitely believe that the 6th EurAsia Waste Management Symposium will provide the opportunity to discuss and evaluate the current and future regional waste management strategies and recycling projects across the Asian and the European regions.

It is my pleasure to thank all the sponsoring companies attended to the Symposium. I would also convey my thanks to all the members of the Scientific Committee for their contribution during the reviewing process of the papers. I would also like to thank all the local organizing committee members of EWMS 2022.

I wish all participants to enjoy the Hybrid Symposium and hope to meet you in 7th EurAsia Waste Management Symposium in 2024.

Sincerely,
Prof. Dr. Ahmet DEMİR
Chairman of the Organizing Committee
Yildiz Technical University, Turkey

24.10.2022 MONDAY	
MAIN HALL	
Opening Program	
08:30	**REGISTRATION**
Opening Ceramony	
09:30	Prof. Dr. Ahmet Demir (Chairman of EurAsia Waste Management Symposium 2022)
09:45	Fatih Hoşoğlu (Deputy General Manager of ISTAC Inc)
10:00	Prof. Dr. Şükrü Ersoy (Dean of Civil Engineering Faculty, Yildiz Technical University)
10:15	Prof. Dr. Tamer Yılmaz (Rector of Yildiz Technical University)
10:30	Prof. Dr. Mehmet Emin Birpınar (Deputy Minister of the Ministry of Environment, Urbanization and Climate Change)
Opening Panel : Moderator: Prof. Dr. Raffaello Cossu	
10:30	Fatih Hoşoğlu (Deputy General Manager of ISTAC Inc)
11:10	Sadiye Bilgiç Karabulut (Head of Circular Economy and Waste Management Department, Ministry of Environment, Urbanization and Climate Change, Directorate General of Environmental Management)
11:50	Prof. Dr. Bestami Özkaya (Vice Rector of Yildiz Technical University)
12:30	**LUNCH**

24.10.2022 MONDAY					
HALL 1		**HALL 2**		**HALL 3**	
Session 1-A : Plastic Waste and Micro-plastics		**Session 1-B : Electronic Waste (WEEE) Management**		**Session 1-C : Industrial Waste Management**	
Session Chair: Prof. Dr. Sadhan K. Ghosh		**ession Chair: Prof. Dr. Perihan Binnur Kurt Kara**		**Session Chair: Prof. Dr. Yaşar Avşar**	
14:00	102_Keynote_Unraveling Microplastics Removal in Conventional Wastewater Treatment Plants in Thailand *S. Babel, K. Tadsuwan*	**14:00**	096_Management of Waste Electrical and Electronic Equipment in Türkiye *M.E. Birpınar, R. Akdeniz, S. Bilgiç Karabulut, S. Ayhan, S.B. Küçük*	**14:00**	028_Treatment of Citrus Juice Process Wastewater with UASB and Biogas Production *S.G. Durak, S. Acarer, G. Türkoğlu-Demirkol*
14:15		**14:15**	025_Gaseous Elemental Mercury Emissions from Selected E-Waste Processing Facilities in Turkey *P.B. Kurt-Karakuş, M. Odabaşı, M.Ö. Akçetin, A. Birgül, M. Kara, Y. Dumanoğlu, J. Syed, F. Wania*	**14:15**	206_A Pilot Scale Modified High-Rate Contact Stabilization Process for Energy-Neutral Wastewater Treatment *E. K. Demir, D. Sancar, E. Şahinkaya, B. Çallı, N. Semerci*
14:30	044_Anaerobic Degradation of Disposable Bioplastics *M.P. Bracciale, G. De Gioannis, M. Falzarano, A. Muntoni, A. Polettini, R. Pom A. Rossi, F. Sarasini, D. Spiga, J. Tirillò*	**14:30**	042_Pre-Treatment Procedure for Effective Bioleaching of Metals from Large Waste Printed Circuit Board (WPCB) Pieces *R. Konakcı, M. Pekcan, Y.Ç. Erşan*	**14:30**	150_Color Removal from Synthetic Textile Wastewater Using a Pilot-Scale Anaerobic Bioreactor *A. Cemanovic, O.A. Arıkan, Ö. Çınar*
14:45	071_Occurrence of Microplastics in Industrial Wastewaters *O. Altuntaş, O. Karakurt, F.D. Sanin*	**14:45**	024_Stockholm Convention Flame Retardant Emissons from Selected E-Waste Processing Facilities in Turkey *M. Odabaşı, P. B. Kurt-Karakuş, A. Birgül, Y. Dumanoğlu, M. Kara, M. Ö. Akçetin, J. Syed*	**14:45**	073_Performance of Terbutryn Removal b Adsorption on Hdtma-Organoclay *D.A. Çınar, D. B. Bartan, E. Ceylan, M. Dönmez*
15:00	023_Microplastic Discharge from a Plastic Recycling Industry Wastewater in Turkey *E.B. Çolakoğlu, İ. Uyanık*	**15:00**	151_Liquid Crystals Recycling from End-of Life LCDs *A.L Barrera, C. Binet, F. Dubois , P.A. Hébért , P. Supiot, C. Foissac, U. Maschke*	**15:00**	142_Adsorption of Divalent Heavy Metals Onto Hydrochar Derived from Lavandin: Synergetic Effect and Related Surface Modification*S.S. Baran, C. Lomenech, G. Verger-Dubois, C. Hurel*
15:15	193_Microplastic Pollution in Wastewater Sea Discharge and Deep Sea Discharge Stations into the Marmara Sea and the Bosphorus *S. Karacam, B.Takataş, N.B. Turan, H.S. Erkan, G.O. Engin*	**15:15**	108_The Selection of Recycling Methods for Waste Lithium-Ion Batteries (LIBs) Used in Electric Vehicles by Multi-Criteria Decision Making *M. Öztürk, E. Evin, A. Özkan, M. Banar*	**15:15**	039_Investigation of The Usability of the Electrocoagulation Method in Malachite Green Removal from Water Solution *H. Arslan , K. Salıcı , M. Gün, M. Yalvaç*
15:30	049_A Comparative Sorption Study for Phenol & Tricholorophenol onto Polyethyle Type Microplastics *A. Adan, B. Koçaş, M. Özdemir, F.D. Sanir İ. İmamoğlu,*	**15:30**	050_Simultaneous Removal of Liquid Crystal and Indium from Waste LCD Panel utilizing Water at Subcritical State *S. Izhar, H. Yoshida, E. Nishio, Y. Utsumi, N. Kakimori*	**15:30**	124_Study of The Discoloration of Organi Pollutant "Basic Fuchsin" Using an Advanc Oxidation Process *H. Naima, O. Bechiri*
15:45		**15:45**	119_Determining the Most Appropriate Upcycling and Recycling Methods for the Management of Waste Printed Circuit Boards *Z.G. Elmas, Z. Günkaya, A. Özkan, M. Banar*	**15:45**	
16:00	**COFFEE BREAK**	**16:00**	**COFFEE BREAK**	**16:00**	**COFFEE BREAK**

Session 2-A : Waste Management and Zero Waste Strategies		Session 2-B : Sludge Treatment and Disposal		Session 2-C : Recovery of Materials from Incineration Ashes	
Session Chair: Prof. Dr. Osman A. Arıkan		**Session Chair: Prof. Dr. F. Dilek Sanin**		**Session Chair: Prof. Dr. Hanife Büyükgüngör**	
16:15	101_Keynote_Role and Design of Sustaina Landfilling as Final Sink in Circular Economy Cycle *R. Cossu, V. Grossule, M. C. Lavagnola*	**16:15**	033_How Do Microplastics Coming from Water Bottles Act in Anaerobic Digestors? Case of Pretreatment or Not *M.D. Hatinoglu, F.D. Sanin*	**16:15**	084_Legal Framework for Bottom Ash Utilization in the Czech Republic *M. Šyc, J. Hykš, T. Baloch, J. Valentin*
16:30		**16:30**	059_Examination of Nylon Microplastics Under Mesophilic and Thermophilic Anaerobic Digestion Process *İ. Şimşek, F.D. Sanin*	**16:30**	085_Possibilities of Resource Recovery an Utilization of MSWI APCr *E. Korotenko, M. Šyc , L. Grič, T. Baloch, J Jadrný*
16:45	163_Monitoring The Solid Waste Management Using GIS And GPS: Study Area of Sheikh Saad, Wasit, Iraq *J.I. Al-badri,S.Mat Taib, M.B. Yusof, N. Saman*	**16:45**	109_Mixing Effect on Bio-Methanation and Dewaterability of Primary and Secondary Sludge *D. Erdirençelebi, R. Yiğit*	**16:45**	107_Composite Phase Change Materials Production from Waste Polyethylenes *H. Akgün, Z. Günkaya, A. Özkan, M. Bana*
17:00	095_Developments in Municipal Waste Management in Türkiye and The Climate Change Context *M.E. Birpınar, R. Akdeniz, S. Bilgiç Karabulut, D. Erdoğan*	**17:00**	111_Long Chain Fatty Acids in Sewage Sludges *D. Erdirençelebi*	**17:00**	164_Municipal Waste Incineration Fly Ash Engineering Applications With a View to Reducing Leaching of Heavy Metal Pollution *M. Jamalimoghadam, A. H. Vakili, A. Saffarzadeh, K. Ulutaş*
17:15	093_Cost Benefits of Zero Waste Approacl Packaging Waste Management in İTÜ Ayazağa Campus *K.E. Maçin, K. Özçelik, O.A. Arıkan*	**17:15**	015_Co-Digestion Potential of Different Industrial Sludge Sources and Impact on Energy Recovery *M.S. Caliskan-Temel, C. Yangin-Gomec*	**17:15**	165_Physicochemical Characterization of Size-Fractionated Municipal Solid Waste Incineration Ash for Metal Recovery *A. Saffarzadeh, R. Tanaka, T. Shimaoka*
17:30	187_Evaluation of the Environmental Dimensions of Sustainability in Terms of Businesses *S. Oztaş, N. Bektaş*	**17:30**	140_Biodegradation of High Cellulose-Lign Content Agricultural Wastes in Bioreactors *Y. Kılıç, R.G. Yılmaz Çinçin, O.N. Ağdağ*	**17:30**	201_Characterization of Poultry Litter Ash Environmental Point of View *İ. Acar*
17:45	045_Geospatial Alternatives for Mapping Environmental Hazards of Dumped Municipal Solid Waste *K. Mahmood, F. Faizi, Y. Yildrim*	**17:45**		**17:45**	181_Energy Potential of C4-Sweet Sorghu Fertilized with Biomass Ash Vermicompos under Bitlis Ecological Condition *G.A. Turp,S. Özdemir*
19:00	**GALA DINNER (YILDIZ HISAR)**				

25.10.2022 TUESDAY					
09:00 17:00	**POSTER PRESENTATIONS (FOYER AREA)**				
Session 3-A : Thermal Conversion Technologies		**Session 3-B : Plastic Waste and Micro-plastics**		**Session 3-C : Landfilling**	
Session Chair: Prof. Dr. Michael Nelles		**Session Chair: Prof. Dr. Sandhya Babel**		**Session Chair: Prof. Dr. Çiğdem Yangın Göme**	
09:15	103_Keynote_Waste Salts Management ar Recycle in China *D. Chen*	**09:15**	128_Effect of CR-39 Plastic Lens Particles Concentration on Biochemical Methane Potential of Organic Wastes *X. Zhao, J.Y. Kim*	**09:15**	173_Treatment of Leachate by Using Blac Soldier Fly Larvae: Effect of Organic Conte Load and Concentration *V. Grossule, R. Cossu, M.C. Lavagnolo*
09:30		**09:30**	080_Interaction of Microplastics with Organics: Ecosystem Impacts and Equilibrium Modeling *Y. Uçkan, M.K. Türkan, İ. İmamoğlu*	**09:30**	149_Factors Affecting Stability and Slope Failure of Landfill Sites: A Review *E. Ekinci, E. Arslankaya*

09:45	133_Evaluating Compost for Hydrogen an Methane Rich Gas Production via Supercritical Water Gasification *E. Yıldırır, N. Cengiz, L. Ballice*	**09:45**	182_Microplastics Removal from Solid Waste Landfill Leachate by Electrocoagulation Process *H.H. Emik, H.S. Erkan, G.O. Engin*	**09:45**	086_Investigation of the Impact of Landfill A and Climate Factors on Landfill Leachate Characteristics *D. Ergene Şentürk, A. Aksoy, F.D. Sanin*
10:00	125_Comparison of the Distribution of H2S COS at Equilibrium Conditions and Steady State Conditions in the Synthesis Gas Durir Passing Through the Empty Column *C. Doğan, B. Çetin, S. Martini, S. Retschitzegger*	**10:00**	126_Recycling Waste Plastic: An Implementation of the Circular Economy Principles or Just Pollution Shift *G. Yılan, A.G. Encino-Muñoz, P. Morone*	**10:00**	138_Rehabilitation Methods for Open Dum and Its Global Applications: SmartEnvi EU Project *O. N. Agdag, R. G. Yilmaz Cincin, S. Toprak, Y. Kaplan, R. Degirmenci, F. Agdag, S. Gebes, B. Cetin, E. De Angelis, Pikon, A. Kujumdzieva, V. Petrova, Panaitescu, D. Frulla, O. Dal, C. Balcik, K De Angelis, F. Dinu, T. Nedeva, M Bogacka*
10:15	137_Effect of Temperature and Flow Rate Agricultural Waste Gasification *R.G. Yılmaz Çinçin, A. Öngen, O.N. Ağda*	**10:15**	079_Triclosan Sorbs Highly on Microplastic *E.Y. Özen, Ü.D. Türkeli, G. Çiftçi, M. Özdemir, F.D. Sanin, İ. İmamoğlu*	**10:15**	110_Biobar: A Proposal of Biological Barrie for A Sustainable Landfill Design *A.K.M. Morita, M. Burmøll, M. Regadio*
10:30	200_Marble Sludges As Environmentally Friendly Catalysts in Olive Pomace Pyrolysis: Effect of Sludge Composition or Pyrolysis Products *G. Göktepeli, E. Yel*	**10:30**	202_Review Paper of The Plastic Wastes Recycling Industries in Kenya. *M.K. Koech, T.A. Busolo*	**10:30**	139_Treatability of Landfill Leachate Usin Three-Stage Hybrid System *A.İ. Erbaş, R.G. Yılmaz Çinçin, O.N. Ağda*
10:45		**10:45**	132_Phthalates in PET Bottles: Assessmer of Human Exposure and Load to Landfills *H.K. Gül, G. Salihoğlu, İ. Ethem Gören, N Daglioglu, P. Kurt-Karakuş*	**10:45**	198_Sudy of Factors Influencing Leachat Characteristics Before Treatment *F.Z. Derias*
11:00	**COFFEE BREAK**	**11:00**	**COFFEE BREAK**	**11:00**	**COFFEE BREAK**

Session 4-A : Waste to Energy		**Session 4-B : Processing of Organic Waste Fractions**		**Session 4-C : Collection, Transport and Characterization of Waste**	
Session Chair: Prof. Dr. Ian D. Williams		**Session Chair: Prof. Dr. İpek İmamoğlu**		**Session Chair: Dr. Kamil B. Varınca**	
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11:30		**11:30**	030_A Comparison of Environmental Impacts of Different Nutritional Diets Via Lif Cycle Assessment *I. Kelhafız, A. Özdemir, A. Özkan, Z. Günkaya, M. Banar*	**11:30**	112_Effects of Route Planning and Optimization with Intelligent Routing Software on Fuel Consumption and Environment *Z.Ö. Duru, N.H. Orak*
11:45	115_Environmental Benefits of Food Waste Water Treatment and Energy Source *H. Çelebi, M. Bilgin , G. Gök, H. Kızıltan, C Gök*	**11:45**	208_Life Cycle Assessment of Three Municipial Solid Waste Management Scenarious in İstanbul *A.Y. Çetinkaya , L. Bilgili*	**11:45**	046_Reduction of Greenhouse Gas Emissions from Municipal Waste Collection Applying Optimization of Transportation Routes Using Ant Colony Algorithm *H. Pamukçu, P. Yapıcıoğlu, M.İ. Yeşilnaca*
12:00	021_Preliminary Investigation of a New Integrated Bio-Electrochemical System for Bio-Hydrogen Production from Cheese Whey *A. Dell'Era, M. Pasquali, A. Polettini, R. Pomi, A. Rossi, T. Zonfa*	**12:00**	072_SWOT Analysis About Zero Waste Management System in Erciyes University, Turkey *B. Akın, O. Özkan, Ş. Aydın, İ. Uyanık*	**12:00**	144_Using Network Analysis Optimization Solid Waste Collection Route: The Exampl of İskenderun (Hatay) County *G.B. Çakmak, A.İ. Karabulut, M.İ. Yeşilnacar, B.Y. Karabulut, P. Derin*

12:15	013_Methane Yield of Paper Industry Was in The Presence of Two Compounds from Alcohol and Aldehyde Groups During Thermophilic Anaerobic Digestion *E. Yarsur , I. Sárvári Horváth, C. Yangin-Gomec*	**12:15**	091_Household Composting in North Syria Case Study *A. Saghir*	**12:15**	074_A Study on Collection and Transportation Route Optimizations for Municipal Solid Wastes *A.İ. Karabulut, B. Yazıcı Karabulut, H. Pamukçu, M.İ. Yeşilnacar, P. Derin*
12:30	034_Biogas Upgrade Techologies and Biomethane Utulization Oportunities *H. Muratçobanoğlu, R.A.Mert, F. Muratçobanoğlu, Ö.B. Gökçek, S. Demirel*	**12:30**	036_The Effect of Bags Law on Environmental Behavior and Habits - Mersi Example *M. Yalvaç, M. Saleh, M. Gün, H. Arslan*	**12:30**	
12:45	170_Evaluation of Biomass Energy Potenti for Western Anatolian Cities *A. Özuysal, G. Akinci*	**12:45**	157_Use of Different Agricultural Wastes a Plant Nutrient Material (Organic Fertilizer) i Strawberry Cultivation *H. Sayğı*	**12:45**	
13:00	**LUNCH**	**13:00**	**LUNCH**	**13:00**	**LUNCH**

Session 5-A : Integrated Solid Waste Management		**Session 5-B : Special Waste Management**		**Session 5-C : Construction and Demolition Waste Management**	
Session Chair: Prof. Dr. Raffaello Cossu		**Session Chair: Prof. Dr. Yılmaz Yıldırım**		**Session Chair: Dr. Yusuf Çağatay Erşan**	
14:00	104_Keynote_Sustainable Management a Recovery of Wastes as Alternative Fuel & Raw Materials through Coprocessing - Cas of Circular Economy in India *S. K. Ghosh*	**14:00**	162_A Bi-objective Optimization Model for Medical Waste Collection Problem *R.A. Arapoğlu*	**14:00**	032_Impact of Circular Silica Aerogel on Plasterboard Recycling *M. Castro-Díaz, M. Osmani, S. Cavalaro, E Parker, T. Lovato, P. Needham, J. Thompson, K. Philippe, F. Ruiz*
		14:15	154_Valuable Component Recovery from Sunflower Oil Production Waste *M.N Kılıçarslan, M.E. Argun*	**14:15**	040_Improvement of Fine Recycled Aggregates by Microbially Induced CaCO Precipitation *E. Arıkan, S.N. Bilici, Y.Ç. Erşan*
14:30	077_Composition and Characteristics of Excavated Materials From a Legacy Waste Dumpsite: Potential of Landfill Biomining *A. Ghosh, S.A. Kartha*	**14:30**	092_Management of Coal Combustıon Products Originated from Thermal Power Plants in Turkey *K. Özçelik, K.E. Maçin, O.A. Arıkan*	**14:30**	043_A Novel Non-Axenic Granulated Cultu Based Microbial Self-Healing Concrete *B. Özbay, Y.Ç. Ersan*
14:45	075_The Future of Solid Waste Manageme in Smart Cities *K. B. Varınca*	**14:45**	035_VUV Induced Photodecomposition o Reactive Textile Dyes With No Sludge Production *H. Derin, S. Sanin*	**14:45**	183_The Performance of Structural Members Incorporating Reinforced Sustainable CO2ncrete *İ. Sarıbaş*
15:00	058_Waste Management Practices in Sustainable Campuses: The Case of Erciye University *B. Salgın, İ. Uyanık, O. Özkan*	**15:00**	153_Waste Management in Hospitals in Turkey: The Case of Tekirdag City Hospita *M. Koncagül , K. Özçelik , K. E. Maçin, O. A Arıkan*	**15:00**	192_The Mechanical Properties of Green CO2ncrete Containing High Proportion RC *A. Caputcu, A. Akyol, H.B. Sari, I. Saribas*
15:15	069_Municipal Solid Waste Management Performance in Rural and Urban Parts of th South Moravian Region *M. Struk, D. Tóthová*	**15:15**	121_Medical Waste Management in Covid 19 Pandemic Process in Sinop: A Case Study *O. G. Baki, A.Yaman*	**15:15**	178_The Effects of Waste Autoclaved Aerated Concrete Powders on the Compaction and Consistency Properties o Kaolin *T. Kevser, H. Çiftçi, H.B. Gençdal, N.Ö. Fercan, Z. Akbay Arama*
15:30		**15:30**	065_Integration of Environmental Impact Assessment to Product Design Stage for Waste Management: Case of Automative Industry *M. Vasef, S. Ayas, S. Tusun, I. Ozturk, E. Topuz*	**15:30**	037_Investigation of the Use of Industrial Solid Waste as a Concrete Additive *Y. Kılıç, M. Yalvaç, M. Gün, H. Arslan*
15:45	**COFFEE BREAK**	**15:45**	**COFFEE BREAK**	**15:45**	**COFFEE BREAK**

Session 6-A : Integrated Solid Waste Management		Session 6-B : Hazardous and Industrial Waste Management		Session 6-C : New Green Deal in Waste Management	
Session Chair: Prof. Dr. Michael Nelles		**Session Chair: Prof. Dr. Sevgi Demirel**		**Session Chair: Prof. Dr. Güleda Engin**	
16:00	106_Keynote _Methods for Raising Public Awareness of Need for Sustainable Waste Management *Ian D. Williams*	**16:00**	189_Bioremediation of Heavy Metals Via Living Microorganisms from Synthetic Wastewater *Y.E. Topaloğlu, Y. Nuhoğlu*	**16:00**	159_Effect of CO2 Source and N Feast-Famine Cycle Over Chlorella Growth *Ü.G. Kıral, İ. Akmırza*
		16:15	147_Zero-Valent Iron Nanoparticles in Soi and Groundwater Remediation; Application Toxicity, Fate and Transport Mechanisms *S.A. Demir, A. Demir, M.S. Bilgili*	**16:15**	195_Microalgal Biorefinery Applications *E. Işık, E. Akkaya*
16:30	184_Characterization of Waste Collected i the Channel Network of the City of Padova the Framework of Urban Mining *V. Poli, G. de Togni, M.C. Lavagnolo*	**16:30**	031_Assessment of Water Quality for Irrigation Purposes: A Case Study of King Talal Reservoir *M.A. Gharaibeh, A. Albalasmeh, O. Mohawesh, M.M. Obaidat*	**16:30**	127_Enhancing Environmental Sustainabil Practices in Laboratories *N. B. Turan, G. Onkal Engin, M.S. Bilgili*
16:45	205_Municipal Solid Waste Characterizatio in Luanda, Angola *A. İ. Kara, E. Tezcan , G. Patar , K. Yıldız M. Bacacı , E. Hacımustafaoğlu, M. Gençosmanoğulları , M.F. Peker , F. Hoşoğlu*	**16:45**	120_An Experimental Study for Heavy Metals Removal Using Bioremediation Technique for Selected Plant Species *A. Hussain, A. Gani, A. Kumar*	**16:45**	204_Problems and Solutions Related to Water in Turkey and in The World *N. A. Tapan, U. Büyükhatipoğlu*
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17:15	041_Biogranules Simultaneously Hydrolysing Urea and Reducing Nitrate an Their Biomineralization Performance *M. Soluk, B. Kardoğan, Y.Ç. Ersan*	**17:15**	029_Green Synthesis of Iron Oxide Nanoparticles Using Spent Black Tea Wast *Ş. Aydın, O. Özkan*	**17:15**	174_Experimental Investigation of Biodies and Acetylene Dual Fuel Use in a Diesel Engine with RCCI Approach *İ. Örs, S. Sarıkoç, S. Yelbey*
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17:45		**17:45**	179_Heavy Metal Removal from Phosphogypsum Using Na2EDTA *E. Çelik, S. Ertunç*	**17:45**	
18:00		**18:00**	131_Synthesis and Adsorption Potential o BC/FeOOH/MnO2 Nanoparticles Using Oil-Squeezed Black Cumin (BC) Seeds as a Waste Material *A. Özgüven, Z. Şirp, D. Öztürk*	**18:00**	

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P2	067_Evaluation of Avocado Peel Based Biochars. As Adsorbent in Methyl Orange Adsorption *İ.D. Ünlü, A.T. Koçer, B. İnan, D. Özçimen*	P9	167_Preliminary Assessment of Potential Disposal Mercury-Saturated Natural and Modified Zeolite Clinoptilolite *A. Jurić, M. Ugrina, I. Nuić, M. Trgo, T. Čeru, M. Gaberšek, M. Miler, M. Gosar*
P3	068_Biochar Production From De-Oiled Microalgae To Be Used in Carbon Nanotube Synthesis and Determination of Pyrolysis Kinetic and Thermodynamic Parameters *A. T. Koçer, G. A. Karaca, B. Karacaoğlu , D. Özçimen*	P10	185_Characterization of Albanian Oil Refinery Wastewater and Simulatıon of a Treatment Plant *I. Malollari , V. Lajqi, M. Krivokapic, L. Liçi, L. Rapaj*
P4	082_Fenton Oxidation of The Concentrated Wastewater of Fruit Processing Industry: Optimization of the Experimental Conditions *Ö. Çakmakçı, M. E. Argun*	P11	038_Some Pharmaceuticals of Water Solution Investigation of Electrochemical Oxidation and Removal *F. Sadıoğlu Kalaycı, M. Gün, M. Yalvaç, H. Arslan*
P5	083_The Evaluation of Post-Consumer PET Water Bottles in The Epoxidized Oil/Oil Based Alkyd Resin Production *E . Yıldırım, O. Yücel, T. Erol, S. Emik, T.B. İyim, İ.Acar*	P12	054_Co- and Individual Pyrolysis of Polypropylene and Polystyrene *K. Polat, G. Özçakır, A. Karaduman*
P6	146_Applications of Nanotechnology for Bio-Remediationof Pesticide-Contaminated Sites *S.A. Demir, F.İ. Türkdoğan, M.S. Bilgili*	P13	057_Co-Pyrolysis of Waste Polystyrene Foam and Microalgae at Low Temperatures *E. G. Ormancı, G. Özçakır, A. Karaduman*
P7	152_Plastics Recycling from WEEE: The Case of Decabromodiphenylether Dispersed in Poly (Acrylonitrile Butadiene Styrene) (ABS) *A. Barrera , H. Aldoori , Z. Bouberka, A. Nadim, Y. Agguine, S. Eddarir, P. Supiot, C. Foissac,U. Maschke*	P14	087_Dairy Effluent Cow Buttermilk (CB): Characterization Its Compositions With X-Ray Fluorescence Spectrometers (XRF) *M. Batoul, B.-K. F. Aziza, B. Hassina, S. Siham, Brahim*

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049 A Comparative Sorption Study for Phenol & Tricholorophenol onto Polyethylene Type Microplastics
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Investigation of the Usability of the Electrocoagulation Method in Malachite Green Removal from Water Solution

Hudaverdi ARSLAN[1], Kemal SALİCİ[2], Melis GUN[3], Mutlu YALVAC[4]

Abstract

In this study, the removal of Malachite Green dye in synthetically prepared aqueous solution by electrocoagulation process was investigated. In the study, initial dye concentration, electrolyte amount, mixing speed, current density, electrolysis time, pH value, and distance between electrodes parameters that affect the removal efficiency of the electrocoagulation method were investigated. As a result of the study, optimum parameters were found as initial dye concentration of 200 mg/L, electrolyte amount of 150 mg/L, stirring speed of 100 rpm, current density of 8 mA/cm^2, pH 4.5 value, the distance between electrodes 1 cm, and electrolysis time 20 min. 93.6% color removal efficiency and 37.5% COD removal were obtained under optimum conditions..

Keywords: Electrocoagulation, Aluminium electrode, Malachite Green, Dyestuff, Wastewater.

1. INTRODUCTION

Negative changes in the chemical, physical, bacteriological, radioactive and ecological characteristics of the water source are defined as water pollution. Water pollution occurs as a result of the discharge of substances or energy wastes that will directly or indirectly cause preventive deterioration in biological resources, human health, fisheries, water quality and the use of water for other purposes [1].

The textile industry is one of the longest and most complex industries in the manufacturing industry. The textile industry consumes a large amount of water in its production processes. The wastewater generated as a result of the textile industry is in the toxic class. These wastewaters, which can be in different colors

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according to the raw material used, spoil the natural appearance of the water environment and reduce the light transmittance. The decrease in light transmittance and dissolved oxygen causes damage to aquatic organisms and prevents the use of water resources [2].

The substances used to color the materials are called colorants. These substances are mainly divided into two as dyestuff and pigment. Dyestuffs can be dissolved in the dyeing process. On the other hand, do not dissolve in the substance to which they are transported.

Malachite green (MG) is one of the basic dyes and is widely used in the dye and textile industry. MG's mixing with water and its high concentration in water cause serious problems for all living organisms, including humans, due to its toxic, carcinogenic, and mutagenic factors. In particular, it shows biological toxicities to humans and living things by consuming fish produced in Malachite green dyed or polluted water and by causing irritating the gastrointestinal tract. Thus, the removal of these organic dyes will directly benefit the environment and living things [3].

Many different methods are used in the treatment of dyestuffs. The toxic properties of dyestuffs and the high content of organic substances resistant to biodegradation in textile wastewater limit the applicability of biological methods [4]. In the treatment with the chemical coagulation/flocculation technique, this method cannot be preferred as a treatment alternative because the sludge formation is higher compared to other methods and because the dyestuffs are dissolved in the wastewater in the enterprises where the reactive dyeing technique is used [5]. Chemical oxidation methods are widely used in the treatment of textile wastewater and their color removal efficiency is high [5]. However, the potential for the formation of substances known to be toxic as a result of oxidation reactions is high [6].

Towards the end of the 20th century, a process called electrocoagulation was developed. This process consists of anode material, cathode material, a conductive liquid power supply components in a reactor [7].

This study, it is aimed to investigate an alternative method for the treatment of wastewater containing dyestuffs. In this context, the removal of Malachite Green dyestuff by electrocoagulation method was investigated and optimum values were determined for initial dyestuff concentration, mixing speed, pH optimization, electrolyte concentration, electrolysis time, current density, and distance between electrodes.

2. MATERIALS AND METHODS

2.1. Materials

Malachite green dyestuff, whose properties are given in Table 1, was obtained from Sigma Aldrich. In the study, AA TECH ADC-3303D brand power supply, Edmünd Bühler GmbH brand mixer and aluminum electrodes with 50 x 70 x 2 mm dimensions and 30 cm^2 active surface area were used. Hack DR-3900 brand spectrophotometer was used to find the dyestuff removal.

Table 1. Properties of Malachite Green Dye

Molecule Formula	$C_{23}H_{25}ClN_2$
Molecular Weight (g/mol)	364.9
Wavelength (λ)	617 nm

2.2. Methods

In the studies, color removal from the aqueous solution prepared in the laboratory with the dyestuff was investigated by the electrocoagulation process. The prepared 2500 mg/L stock solution was stored under cold and dark conditions and diluted with distilled water to bring it to the desired concentration.

The dyestuff prepared at the desired concentrations in the experiments was added to the 600 ml beakers against the risk of overflow by using 250 ml volume and put into the system. Then, the variables of dyestuff concentration, electrolyte amount, current density, pH, mixing speed, the distance between electrodes, and electrolysis time were investigated to find the optimum conditions.

Two electrodes, 1 anode and 1 cathode, were used in the monopolar connected state inside the reactor. The distance between the electrodes was adjusted to 1 cm until the optimum value was found.

In the experiments, 0.1 M HCl and 0.1 M NaOH chemicals were used to adjust the pH value. The electrodes were kept in the cleaning solution for 10 minutes before the experiments and after being washed with distilled water, they were dried and made ready for weighing and the next experiment.

During the experiment, 5 ml samples were taken from the system and the samples were subjected to centrifugation at 6000 rpm for 5 minutes and analyzed in a spectrophotometer at 617 nm.

2.3. Equations Used in Calculations

In Table 2, the equations of the calculations made as a result of this study and the explanations of the parameters applied when using these equations are given.

Table 2. Equations Used in Calculations

Calculated Parameter	Equation	Parameters to use
Current Density	$J = \frac{I}{2 \times S}$	• J : Current density (mA/cm^2) • I : Current intensity (mA) • S : Electrode area
Dyestuff Removal	$Dyestuff\ removal\ (\%) = \frac{(C0 - Ct)}{C0} X100$	• C_0 : Initial dyestuff concentration • C_T : Dye concentration at time T
Mole Amount of Substance to Precipitate	$m = \frac{I\ x\ t}{n\ x\ F}$	• I : Current Intensity (Amps) • t : Time (sec) • n : Ion charge (+3 will be taken for aluminum) • F : Faraday constant (96485 ^{0}C mol^{-1})
Theoretical Amount of Dissolution at the Anode Electrode	M_{ATe} = m $\times$ (M_W)	• M_{ATe}: Theoretical Amount of Dissolution at the Anode Electrode • M_W : Molecular weight
Current Efficiency	$E = \frac{M_A}{M_{ATe}}$	• E : Current Efficiency • M_A : The amount of dissolution in the anode electrode material in the experiment (g)
Total amount of dissolved aluminum (M_T)	$M_T = M_A + M_K$	• M_K : The amount of dissolution in the cathode electrode in practice (g)
Energy Consumption Value	$W = \frac{V \times I \times t}{v}$	• W : Energy Consumption Value (kW.hour/m^3) • V : Potential Difference Occurring in the System • I : Applied Current Intensity • T : time (hour) • v : Total Solution Volume in the Reactor
Energy Consumption	$Ec = V \times I \times t$	• Energy Consumption (Ec) • V: potential difference (volts) • I: Current flowing through the circuit (ampere) • t: Process time (hours)
Chemical Oxygen Demand	$COD\ (mg\ L) = \frac{(A-B)xNx8000}{Sample\ (ml)}$	• A: Iron Ammonium Sulphate consumption of the blind (mL) • B: Iron ammonium sulfate consumption of the sample (mL) • N: Normality of Iron Ammonium Sulphate Solution (N)

3. RESULTS AND DISCUSSION

3.1. Optimization Parameters

3.1.1. Initial Dye Concentration

In the electrocoagulation process working with aluminum electrodes, solutions with concentrations of 50, 100, 150, 200 and 250 mg/L were prepared and their removal efficiencies were investigated in order to determine the optimum concentration in the aqueous solution containing the dyestuff. Other parameters in the process; The amount of electrolyte was 100 mg/L, stirring speed was 100 rpm, current density was 6 mA/cm2, the distance between the electrodes was 1 cm, the electrolysis time was 30 minutes and the original

pH was used. As the concentration value increased, the removal efficiency decreased from 99.88% to 76.88%, and it was observed that the required time for removal was prolonged. At the beginning of the study, it was observed that the removal efficiency of wastewater with high concentrations was lower compared to the studies with low dye concentrations. When Figure 1 is examined, since electricity consumption is taken into account in terms of treatment cost, it is determined as 200 mg/L with less energy. Figure 2 shows the effect of initial concentration on color removal efficiency and energy consumption.

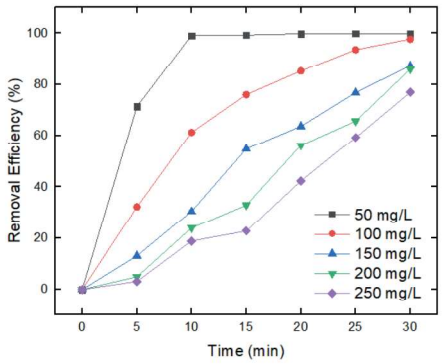

Figure 1. Results of color removal efficiency versus time with Al electrode at different initial concentrations (C_{salt}=100 mg/L, 100 rpm, J=6 mA/cm^2, original pH, Electrodes Distance=1 cm, t=30 min)

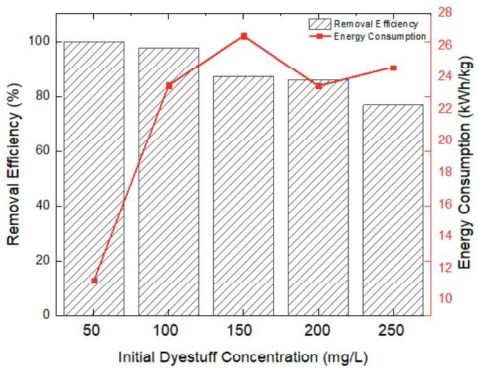

Figure 2. Effect of initial concentration on color removal efficiency and energy consumption (C_{salt}=100 mg/L, 100 rpm, J=6 mA/cm^2, original pH, Electrodes Distance=1 cm, t=30 min)

3.1.2. Electrolyte Amount

The pollutant removal efficiency and operating cost are related to the conductivity of the solution. The conductivity of the solution is adjusted by adding salts such as sodium chloride and sodium sulfate to the wastewater with low conductivity [8]. After the initial dyestuff concentration was determined as 200 mg/L, the amount of electrolyte was determined. In order to determine the optimum amount of electrolyte, NaCl concentrations of 50, 100, 150, 200 and 250 mg/L were added to the solution and their removal efficiencies were investigated. It was observed that as the amount of NaCl increased, the removal efficiencies increased from 69.5% to 93.5%. As the amount of added NaCl increased, the solution conductivity also increased, and accordingly, the voltage value decreased. As the voltage value decreased, the required energy amount also decreased. It was observed that the energy consumption value for kilogram pollutant amount decreased from 35.9 to 3.69 kWh/kg as the amount of electrode increased. When the kilogram pollutant amount and removal graph were examined, it was seen that the optimum NaCl amount was 150 mg/L and the removal efficiency was 88.05%. In the study, the amount of electrolyte was determined as 0.15 g/L. Higher removal was achieved with less amount of NaCl. Figure 3 shows the effect of electrolyte concentration on color removal efficiency and energy consumption.

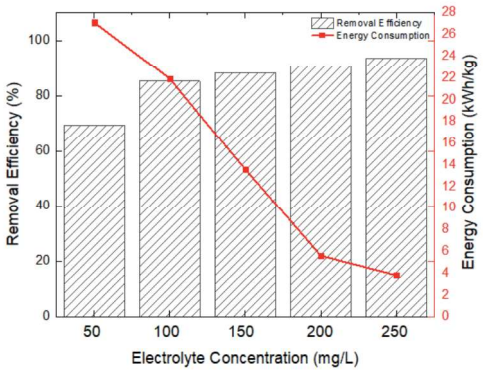

Figure 3. Effect of electrolyte concentration on color removal efficiency and energy consumption (C_0=200 mg/L, 100 rpm, J=6 mA/cm^2, original pH, Electrodes Distance =1 cm, t=30 min)

3.1.3. Mixing Speed

Stirring prevents the formation of a concentration gradient from the electrocoagulation cell and increases the velocity of the ions in the cell. As the mixing speed increases, the pollutant removal efficiency increases. After the amount of electrolyte was determined, the mixing speed was determined. In order to determine the optimum mixing speed, the mixer 100, 150, 200, 250 and 300 rpm values were set on the magnetic stirrer. It was observed that the removal efficiency decreased as the mixing speed increased. Increasing the mixing speed requires extra energy. In Figure 4, the effect of the change in mixing speed on the color removal efficiency and energy consumption is given. When Figure 4 is examined, it is seen that the removal efficiency decreases when the mixing speed is increased. The optimum mixing speed was determined as 100 rpm.

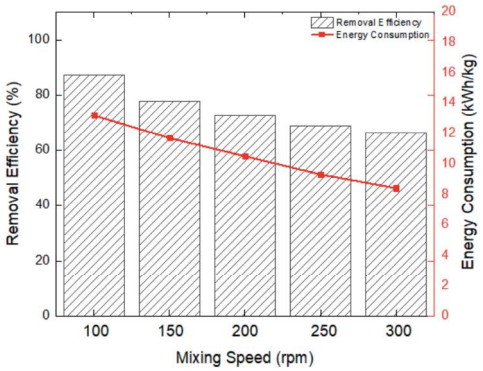

Figure 4. The effect of change in mixing speed on color removal efficiency and energy consumption (C_0=200 mg/L, C_{salt}=150 mg/L, J=6 mA/cm^2, original pH, Electrodes Distance =1 cm, t=30 min)

3.1.4. Current Density

Current density affects electrocoagulation efficiency, coagulation rate, bubble generation rate and size. The anodic dissolution rate increases with the increase in current density. In this way, the number of metal hydroxide clumps increases, increasing the pollutant removal efficiency [8]. It is one of the most important parameters that directly affect the removal efficiency in the electrocoagulation process. After the mixing speed was determined, the current density was determined. 2, 4, 6, 8 and 10 mA/cm^2 are set on a digital power supply to determine the optimum current density. It was observed that the removal efficiency increased as the current density increased. As the current density increases, the amount of energy required also increases. As seen in Figure 5, it has been observed that the difference between the applied current density and the removal efficiency does not increase much as it approaches the highest value. Since the removal values between 10 mA/cm^2 and 8 mA/cm^2 are close to each other, 8 mA/cm^2 was determined as the optimum current density.

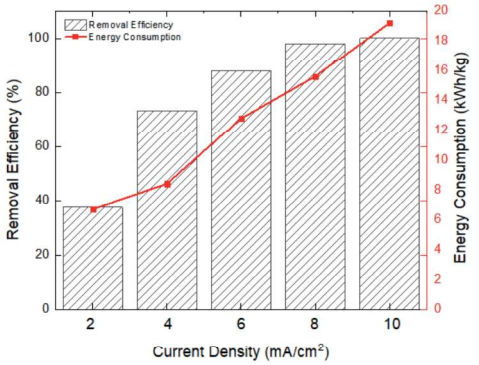

Figure 5. The effect of current density on color removal and energy consumption(C_0=200 mg/L, C_{salt}=150 mg/L, 100 rpm, original pH, Electrodes Distance =1 cm, t=30 min)

3.1.5. pH Effect

pH is an important factor as it directly affects the reactions taking place in the electrocoagulation process. It is important both because of the formation of hydroxyl radicals at the cathode and the presence of metal hydroxides at the anode. After the current density was determined, the pH value was determined. In order to find the optimum pH value, solutions of 2.5 -4.5 -6.5-8.5 were prepared. It was observed that the difference between pH value and removal efficiency did not increase much as it approached the highest value. At the end of 20 minutes, when the pH value was 4.5 and 6.5, the removal efficiency was found to be 98.28% and 96.95%. The optimum pH value was determined as 4.5. It has been observed that pH changes do not directly affect the processing time. The effect of pH change on color removal and energy consumption is given in Figure 6.

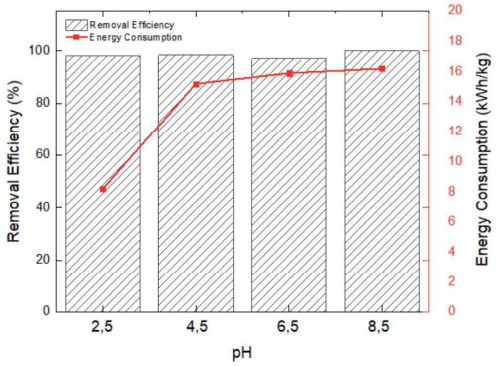

Figure 6. The effect of pH change on color removal and energy consumption (C_0=200 mg/L, C_{salt}=150 mg/L, 100 rpm, J=8 mA/cm^2, Electrodes Distance =1 cm, t=30 min)

3.1.6. Distance Between Electrodes

Here, the effect of the distance between the electrodes on the removal efficiency was investigated. In order to find the most suitable distance between the electrodes, the effect on the removal efficiency was examined by opening 1-1.5-2 cm between the electrodes. It was observed that the removal efficiency decreased when the distance between the electrodes was increased. It was observed that the energy consumption increased when the distance between the electrodes was increased. When looking at the time-dependent removal graph, it was seen that the highest yield was obtained in the 1 cm range. In Figure 7, the effect of the distance between the electrodes on color removal and the energy consumption is given.

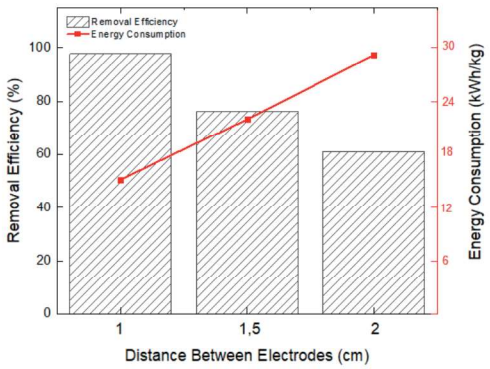

Figure 7. The effect of the distance difference between the electrodes on color removal and energy consumption (C_0=200 mg/L, C_{salt}=150 mg/L, 100 rpm, J=8 mA/cm^2, original pH, t=30 min)

3.1.7. Electrolysis Time

If the electrolysis time changes, the amount of ions and hydroxide flocs produced change. In order to determine the optimum electrolysis time, the results of the previous experiments were evaluated. When evaluated together with other optimum parameters in the process, the optimum time was found to be 20 minutes. It was observed that the removal efficiency increased as the electrolysis time increased (Figure 8). It has been observed that the removal is reduced if the electrolysis time is extended more than necessary.

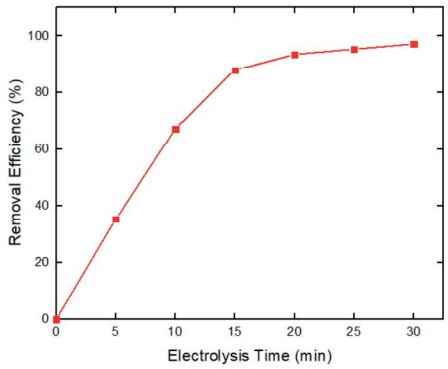

Figure 8. The effect of electrolysis time on color removal (C_0=200 mg/L, C_{salt}=150 mg/L, 100 rpm, J=8 mA/cm^2, original pH, Electrodes Distance =1 cm)

3.2. Calculations Based on Optimum Values

In Table 3, the results of the calculations made according to the optimum values of the study and in Table 4, the results of the analysis made under the optimum conditions are given.

Table 3. Calculation results according to optimum values

Parameter	Results
Current Density (J)	8 mA/cm^2
Current Efficiency (E)	0,80
Total Dissolved Aluminum Amount (M_T)	0,0431 g
Energy Consumption (W)	10,58 kW.saat/m^3
Electricity Cost	5,22 TL/m^3
NaCI Cost	0,594 TL/m^3
Aluminum Cost	5,405 TL/m^3
Chemical Cost	0,594 TL/m^3

Table 4. Analysis Results at Optimum Conditions

	Initial	Final
Temperature ^{0}C	21	29
pH	4,40	6,17
Conductivity (µS)/cm	1728	614
COD (mg/L)	2561	1604
Color (Pt-Co)	3500	260

4. COMPARE OTHER STUDIES

Table 5 shows what some other researchers have done before; optimum conditions of dye solution removal from aqueous solutions by electrocoagulation are given.

Tablo 5. Compare with other studies

DyeStuff	Parameters	Electrode	Dye Stuff Removal	References
Remazol Brillant Blue	Dyestuff Concentration: 100 mg/L, Current Density:1 A/m^2, Electrolysis time: 20 min	Al	%98.1	[9]
Remazol Brillant Blue	Dyestuff Concentration: 50-200 mg/L, Current Density: 0,5-5 A/m^2	Al	%99.6-98.2 %96.8-99.4	[10]
Procion Yellow H-EXL	Dyestuff Concentration: 500 mg/L, Elekcrolide concentration: 6,5 mg/L, Current Density: 7 mA/ cm^2	Fe	%91.5-98.4	[8]
Metilen Blue	Dyestuff Concentration: 100 mg/L, Current Power: 20 A	Al	%94	[11]
Reaktif Yellow 160	Current Density: 100 A/ m^2 Electrolysis time: 10 min Dyestuff Concentration: 100 mg/L,	Al	%96.4	[5]
Direct Red 23	Current Density: 0,1 mA/cm^2 Mixing Speed:150 rpm	Al	%98	[12]
Basic Blue	Current Density: 333 A/m^2 pH 8	Al	%97	[13]
Malachite Green	Dyestuff Concentration: 150 mg/L, Electrolysis time: 20 min pH 8	Paslanmaz Çelik	%99,5	[14]
Malachite Green	Dyestuff Concentration: 100 mg/L, Current Density: 76,5 A/m^2 pH 8 Electrolysis time: 30 min	Al-Fe	%99.9	[15]
Malachite Green	Dyestuff Concentration: 200 mg/L Current Density: 8 mA/cm^2 Electrolysis time: 20 min	Al	%94.5	This Study

5. CONCLUSIONS

In this study, the effects of electrocoagulation process operating parameters on color removal were investigated. Optimum conditions in the process; The initial dyestuff concentration was 200 mg/L, the electrolyte amount was 150 mg/L, the stirring speed was 100 rpm, the current density was 8 mA/cm^2, the pH was 4.5, the distance between the electrodes was 1 cm, and the electrolysis time was 20 minutes. During the studies, it was observed that color removal increased over time. It was observed that the color removal efficiency decreased when the initial dyestuff concentration was increased. It was observed that the amount of dissolution from the anode increased when the current density was increased. It was observed that the required power amount decreased when the amount of electrolyte added to increase the conductivity was increased. As a result of increasing the current too much, the water temperature increased after the paint was removed.

In this study, 93.6% removal efficiency and 37.5% COD removal efficiency were achieved after 20 minutes in the removal of malachite green dyestuff in an aqueous solution by electrocoagulation method under optimum conditions. Color measurement was made from the Pt-Co unit under optimum conditions and 92.5% removal efficiency was observed.

The necessary consumption calculated in the examination of the treatability of synthetic wastewater prepared with malachite green dyestuff was calculated according to the unit energy price of January 2021, and the energy cost to treat 1 m^3 of wastewater was found to be 11.22 TL/m^3. The electrocoagulation process has succeeded in providing a high rate of color removal in wastewater containing dyestuffs, but it has been found to be insufficient in COD removal. It should be used together with other treatment processes in wastewater with high COD value.

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