Journal of Advances in Science and Technology

Vol. X, Issue No. XX, November-2015, ISSN 2230-9659

AN ANALYSIS UPON SYNTHESIS OF NOVEL RESINS FOR IMPROVE WATER QUALITY AND TREATMENT OF YAMUNA RIVER

AN INTERNATIONALLY INDEXED PEER REVIEWED & REFEREED JOURNAL

www.ignited.in

Journal of Advances in Science and Technology
Vol. X, Issue No. XX, November-2015, ISSN 2230-9659

An Analysis upon Synthesis of Novel Resins for Improve Water Quality and Treatment of Yamuna River

Nitika Kohli[1]* Dr. Arun Kumar Suthar[2]

[1]Research Scholar, Jodhpur National University, Rajasthan

[2]Assistant Professor

Abstract – Water is one of the prime elements responsible for life on the earth. India's surface water flows through 14 major river basins beyond innumerable medium/minor basins. The climate change is affecting the precipitation and ultimately affects the quantity of freshwater available, whereas, increasing waste water loads from point and non-point sources are deteriorating the quality of surface wateras well as ground water resources. The surface water quality is a very important and sensitive issue and is a great environmental concern worldwide. Surface water pollution by chemical, physical, microbial and biological contaminants can be considered as an epidemic all over the world.

Water quality is a significant criterion in matching water demand and supply. Ample degree of freshwater is eminent for biological needs are a vital side of integrated environmental management and sustainable development. The quality of water indices estimation endeavor single value which decrease the big quantity of parameters and represent data in a simple way.

The resin was found to be stable in acidic as well as in basic medium. Physicochemical properties of the resin were examined. The total caution exchange capacity was measured and effect of pH and metal ion concentration on ion exchange capacity were studied. The distribution coefficients at different pH were also studied using batch equilibration method.

----------♦----------

INTRODUCTION

Entering into the 21st century, science and engineering has made great strides in its technological advances for the treatment and handling of wastes related to chemicals and allied products. Having an origin that began with attempting to comply with federal regulations, the types of mechanisms that have been purposed to handle various wastes has changed due to increasing knowledge within the field. This can be attributed to the interdisciplinary collaboration between various science and engineering fields. While conventional waste handling techniques such as landfilling and conventional wastewater treatment are still in use, the emphasis has changed to reduce the amount of product following treatment and somehow generate a product from waste collected. This has led to the popularity of many techniques such as ozonation, ultraviolet irradiation, and other chemical treatment methods. With the use of these new technologies, one is capable of treating wastes that have not been treated before due to the possible problems associated with using traditional methods. Having a plethora of opportunities to explore new technologies, it is therefore important to make a concerted effort to consider what has occurred within waste handling and treatment.

Water pollution due to toxic metals and organic compounds remains a serious environmental and public problem Moreover, faced with more and more stringent regulations, water pollution has also become a major source of concern and a priority for most industrial sectors. Heavy metal ions, aromatic compounds (including phenolic derivatives, and polycyclic aromatic compounds) and dyes are often found in the environment as a result of their wide industrial uses. They are common contaminants in wastewater and many of them are known to be toxic or carcinogenic. For example, chromium (VI) is found to be toxic to bacteria, plants, animals and people.

Mercury and cadmium are known as two of the most toxic metals that are very damaging to the environment. In addition, heavy metals are not biodegradable and tend to accumulate in living organisms, causing various diseases and disorders. Therefore, their presence in the environment, in particular in water, should be controlled. Chlorinated

phenols are also considered as priority pollutants since they are harmful to organisms even at low concentrations. They have been classified as hazardous pollutants because of their harmful potential to human health. 2,4,6-trinitrotoluene (TNT) is a nitro-aromatic molecule that has been widely used by the weapon industry for the production of bombs and grenades. This compound is recalcitrant, toxic and mutagenic to various organisms . Many synthetic dyes, which are extensively used for textile dyeing, paper printing and as additives in petroleum products are recalcitrant organic molecules that strongly color waste water.

Heavy metals can be removed from effluents using chemical reduction, electrochemical treatment, ion exchange, precipitation with hydroxides, carbonates and sulphides, evaporative recovery or adsorption onto activated carbon, for instance.

These methods are expensive and inefficient in many cases, however, especially when the metal concentration is low (<100 ppm). The sludge generated in the precipitation method also poses challenges in connection with its handling, treatment and disposal by landfilling, while ion exchange requires high capital and operational costs due to the chemicals used for the regeneration of resins. Electrolysis is an advantageous method if the concentration of metals is high, but it is inefficient at low metal concentrations.

The present investigation concerns a further application of direct introduction/AAS to determine heavy metals at sub-ppb levels in water. This method involves pre- concentration of Co, Ni, Cu, Cd, Sn, Pb, and Bi with an IED. Furthermore, the discussion is extended to elemental mapping, the size of the small disk, the atomization conditions, and the calibration curves and detection limits. The detection limits of the proposed method are also compared with those reported in the literature. The proposed method was successfully applied for the determination of the seven analytes in tap water, rainwater, river water, and mineral drinking water.

The demand of fresh water has been continuously increasing with growing population and increase in agricultural and industrial activities. Majority of the demand of water of Delhi, Haryana, Uttar Pradesh and Madhya Pradesh states is met by Yamuna, which has already become a sewerage drain. This study aims to discuss the most prominent reasons of Yamuna river pollution and easily feasible and economically feasible measures to prevent further pollution and improve the river water quality.

MIEX RESIN WATER TREATMENT PROCESS

Sources of colour in ground water can include metallic ions (iron and manganese), and dissolved natural organic material (NOM, humic and fulvic acids). Conventional processes used for colour removal in water treatment include oxidation and precipitation of metallic ions and coagulation, flocculation, and filtration of NOM. The removal of dissolved organic material (or carbon – DOC) from drinking water sources has become a major concern since trihalomethanes were found in chlorinated drinking water in 1974. In addition, reducing DOC reduces chlorine demand and can help prevent taste and odour problems in distribution.

The anion exchange process is an attractive method for removing DOC because the majority of these compounds are acidic (ionic). Conventional ion exchange systems have been and still are successfully used for the colour removal in water treatment, however for relatively small size waterworks (1–60MLD).

Scaling up of the conventional ion exchange processes to several hundreds of ML/day would require complex and costly infrastructure and substantial amounts of resin.

In response to these shortcomings of conventional approaches a new process was developed in Australia and has been extensively trialed over several years. This process is based on a new, specially formulated and patented MIEX resin. Special features of this resin enabled it to be used in infrastructure that closely resembles conventional water treatment plants and is very different to ion exchange columns.

NOVEL ION EXCHANGE PROCESS FOR ARSENIC AND NITRATE REMOVAL

Anion exchange is an attractive technology for removing arsenate from drinking water and is the preferred technology for removing nitrate, because of its ability to remove these ions almost quantitatively from solution, the insensitivity of the process to solution pH, and the long effective lifetime of the resins.

However, the economics of the process are very sensitive to the concentration of competing ions in the solution. In particular, at the concentrations present in many water supply sources, sulfate occupies the majority of the binding sites on such resins and thereby decreases the volume of influent that can be treated before regeneration is required; in cases where arsenate is the target contaminant, nitrate can also be an important competing species . In addition to the loss of production during regeneration, the costs of brine preparation and disposal diminish the attractiveness of ion exchange if the competing ions are present at high concentrations.

In prior work, we described a treatment process for arsenate in which two ion exchange columns are used in series and, in each cycle, the arsenate chromatographic peak is allowed to pass entirely into the downstream column before the upstream column

is regenerated. The regenerated column is then returned to the treatment train in the downstream position. In this way, virtually all the arsenate entering the system is retained within the columns for long periods of time. When the process was tested using a laboratory-scale treatment system fed an influent containing 40 mg/L As(V) and 80 mg/L SO4, the effluent As(V) concentration was typically o1 mg/L, and a negligible fraction of the sorbed As(V) was released during column regeneration in tests treating >36,000 bed volumes (BVs) of water. That work also demonstrated that sulfate could be removed from the regenerant brine by precipitation of either BaSO4(s) or CaSO4(s), so that the brine could be reused numerous times.

WATER QUALITY STATUS OF YAMUNA RIVER

The River Yamuna is the largest tributary of River Ganga. This river is as prominent and sacred as the great River Ganga itself. It has been acclaimed as a holy river in Indian mythology and various pilgrimage centers e.g. Yamunotri (Uttaranchal), Paonta Sahib (Himachal Pradesh), Mathura, Vrindavan, Bateshwar & Allahabad (all in Uttar Pradesh) are located at the banks of this river. Large urban centers e.g. Yamuna Nagar, Sonepat, Delhi, the political nucleus of India, Gautam Budh Nagar, Faridabad, Mathura, Agra and Etawah are also established on its banks. Large industrial centers have also been developed either on banks or in its basin. In agriculture front also the Yamuna basin is one of the highly fertile and high food grain yielding basin, especially areas in Haryana and Western district in Uttar Pradesh. All this reflects that the River Yamuna not only flows in the hearts of Indian but also plays a significant role in the economy of the country. This river Yamuna is also influenced by the problems imparted by industrialization, urbanization and rapid agricultural developments similar to other riverine system.

In India, the River Yamuna, the main source of water supply to Delhi, suffers from deteriorating water quality. The increasing population has mainly resulted in various anthropogenic activities contributing to water quality deterioration. The major contaminant sources include domestic wastes and industrial effluents. The large demand for water supply and associated sanitation conditions due to the lack of supply in Delhi has resulted in severe water-quality variations of the River Yamuna.

LITERATURE REVIEW

A literature survey, discusses their application in surface water quality analysis. A short note on the newly applied absolute principal component score-multiple linear regression (APCSMLR) receptor model on hydrological studies is also supplied in this communication.

The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. Natural water contains different types of impurities are introduced in to aquatic system by different ways such as weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and the use of metal based materials. The increased use of metal-based fertilizer in agricultural revolution of the government could result in continued rise in concentration of metal pollutions in fresh water reservoir due to the water run-off.

Delval et al. (2000) as adsorbents for the recovery of various organic pollutants from aqueous solutions. The particles can be packed in sorption columns, which are perhaps the most effective devices for the continuous removal of pollutants. In two other works, they prepared cross-linked starch containing tertiary amine groups by reticulation of a starch-enriched flour in the presence of NH4OH.

Basil et al. (2001) found that conventional uncertainty analysis by the Root Sum Square (RSS) method was often difficult in complex systems and required approximation at each stage of processing placing serious doubts on the validity of the results. They observed that recent developments in the analysis of uncertainty using Monte Carlo Simulation (MCS) had resolved many of the problems. These included non-symmetric uncertainty distributions, nonlinearity within the measurement system, input dependency and systematic bias. Monte Carlo simulation was devised as an experimental probabilistic method to solve difficult deterministic problems since computers can easily simulate a large number of experimental trials that had random outcomes. When applied to uncertainty estimation, random numbers were used to randomly sample parameters' uncertainty space instead of point calculation carried out by conventional methods.

Liu et al. (2003) prepared new hybrid materials that adsorb transition metal ions by immobilizing chitosan on the surface of non-porous glass beads. Column chromatography on the resulting glass beads revealed that they have strong affinities to Cu(II), Fe(III) and Cd(II). The sorption capacities of the two kinds of supports was very close for a given pollutant. The adsorption isotherms were correlated with the Langmuir and Freundlich models and permit to conclude that the sorption mechanisms depend mainly on the structure and the concentration of the pollutant. The sorption capacities depend on the cyclodextrin content. However, the authors concluded

that it is unnecessary to have a high CD content to improve the sorption.

Juahir et al. (2004) discussed the development of Artificial Neural Network (ANN) model in estimating water quality index (WQI). An ANN model was developed and tested using data from 30 monitoring stations. The modelling data was divided into two sets. In the first dataset, ANNs were trained, tested and validated using six independent water quality variables as input parameters. Consequently, Multiple Linear Regression (MLR) was applied to eliminate independent variables that exhibited the lowest contribution in variance. MLR was applied in the work to justify the relationship between water quality parameters and their impact on WQI. In second dataset, only four independent variables were used to train, test and validate the ANNs. ANN models were found to be capable of estimating WQI with acceptable accuracy when they were trained by eliminating the independent variables.

Pawar Anusha et al.(2006) has studied the bore well and dug well water samples from a highly polluted industrial area – Nacharam. Sample were collected and analysed for physico-chemical parameters by adopting the standard methods for examination for water and waste water. The analyzed samples obtained a high values, compared with drinking water standards. Poonkothai and Parvatham (2005) had been studied physico-chemical and microbiological studies of automobile wastewater in Nammakkal, Tamil Nadu, India indicated that the values for physico-chemical parameters were on the higher side of permissible limits of BIS. Microbiological studies revealed the presence of bacteria at high concentration and these organisms serves as indicators for pollutants.

Schiffman et al.(2008) considered odor emissions from swine facilities modeling at a distance from 200 and 400 m downwind using an Eulerian-Lagrangian model. The results found that odor did not extend beyond a 400 m, as long as the air was not turbent within the day, while at night, cooling where stable boundary layer by long wave radiation, also swine housing was based on odor along with sources as compared to waste management types.

Cobo et al. (2009) compared 2-propanol and molecular H2/MeOH as reducing agents for hydrodechlorination of dioxides with a 2% wt of Pd/gamme-Al2O3 and concluded that complete dioxin degradation occurred when 2-propanol was a reducing agent and solvent, as compared with using H2/MeOH which diminished the efficiency .

Muhle et al.(2010) compared municipal solid waste in Germany and the United Kingdom for overall emissions, where it was determined that Germany relied more on recycling and recovery as compared to the United Kingdom. The values reflected CO2 emissions of 175 kg CO2 equivalents/t in Germany, versus 34 kg CO2 equivalents/t in the United Kingdom.

Eneji et al. (2012) investigated the spatial and temporal variation in water quality parameters at ten different locations along River Benue in Nigeria for twelve consecutive months. In order to explore the spatial variation among different stations and seasonal changes, multivariate analysis of variance (MANOVA) was used to group these data on the basis of spatial similarities. Discriminate analysis used in the study identified all the parameters to discriminate between the three seasons of a year with 99.2% correct accuracy assignations.

Saatsaz et al. (2013) evaluated spatio-temporal distributions of groundwater quality were evaluated for 23 different stations in the plain using multivariate statistical techniques. After descriptive analysis, Multivariate Analysis of Variance technique (MANOVA) and Cluster analysis (CA) were performed to measure significant effects of spatial, seasonal and annual differences on mean concentration of key hydro chemical parameters of groundwater. The MANOVA results explained that the interaction of location on seasonal variables was significant to increase the variations. In addition, the results of cluster analysis showed a 3-cluster dendrogram which reflects variations in natural and human activities.

METHODOLOGY

Several research studies had been carried out at River Yamuna between 1947-1976 by various organizations. However, these studies were irregular, unsystematic and limited in the scope. There had been rapid urbanization, industrialization and agricultural development in Yamuna basin after 70's, which is still ongoing. All these developments are water dependable and the water requirement is met from the River Yamuna. Alongwith the developmental activities in the catchment area, the River Yamuna water influenced greatly both in term of quantity and quality because it is well known fact that human activities requires fresh water and generates wastewater generally having final destination into river. Necessity of a welldeveloped water quality monitoring network for the riverine system of the country including River Yamuna that provides water quality status regularly and systematically was considered necessary for water and wastewater management, development of rational pollution control programme etc.

Various sampling locations were selected along the Yamuna river at Delhi (e.g. Okhla based industries, River Yamuna, Hindon River etc.). The water samples are collected from different sites of Yamuna river, in three seasons, viz. winter, summer, and monsoon. The water samples for trace element analysis were collected in acid leached polyethylene bottles and preserved by adding ultra-pure nitric acid (5 mL/lit)

Samples for bacteriological analysis were collected in sterilized high density polypropylene bottles. All the samples were stored in sampling kits maintained at 4°C and brought to the laboratory for detailed chemical and bacteriological analysis.

In the study the results of the sorption of heavy metal ions such as Cu(II), Zn(II), Cd(II) and Pb(II) in the presence of the complexing agents of a new generation Baypure CX 100 (IDS) and Trilon M (MGDA) on commercially available chelating ion exchangers are presented.

CONCLUSION

Yamuna which acts as the life line for the majority of the cities like Yamuna Nagar (Haryana), Panipat, Sonipat, Delhi, Noida , Faridabad, Mathura and Agra plays a major role in polluting the river. Yamuna river flow is restricted through several barrages such as Tajewala barrage, Wazirabad Barrage, Okhla Barrage, Gokul barrage etc. These barrages are directly or indirectly affecting the river water quality and aquatic ecosystem. Sludges which contain inorganic, organic and other toxic matters usually get deposited at the upstream of the barrages and their sudden release in the downstream of the river water increases pollution level so high that led to the mass death of fishes especially Delhi and Eutriphicated segment frequently.

The quality restoration of any river, especially of the Yamuna at different locations, is a very complex and interdisciplinary endeavor. Yamuna River pollution cannot be minimized merely by diverting the routes of different drains carrying wastewaters and/or establishing sewage treatment plants. The required strategy for pollution control should not only be a multi-line approach but also be fool proof. The various sources of pollution in the Yamuna river and possible strategies to restore this ailing river to its pristine status must be thoroughly examined and effective and enduring solutions established and implemented.

This study presents the usefulness of multivariate statistical techniques of large and complex dataset in order to obtain better information and interpretation concerning surface water quality.

REFERENCES

Ashraf MA, Mahmood K, Wajid A. (2011). Study of low cost biosorbent for biosorption of heavy metals. International Conference on Food Engineering and Biotechnology, 9, IACSIT Press, Singapoore.

Brower, J.B., Ryan, R.L., Pazirandeh, M. (1997). Comparison of ion-exchange resins and biosorbents for the removal of heavy metals from plating factory, Environmental Science and Technology, Vol. 31, pp. 2910-2914.

Chen X, Chen G, Yue PL. Novel electrode system for electroflotation of wastewater. Environ Sci Technol 2002; 36: pp. 778–83.

Cobo, M.; Conesa, J.A. (2009) ; Montes de Correa, C. Effect of the reducing agent on the hydrodechlorination of dioxins over 2 wt.% Pd/gamma-Al2O3. Appl. Catal. B., 92, pp. 367-376.

Delval F, Vebrel J, Pont P, Morcellet M, Janus L, Crini G. (2000). Sorption properties toward aromatic compounds of insoluble crosslinked polymer containing starch derivatives. Polym Recycl;5: pp. 137–43.

Duffus, J.H. (2002). Heavy metals" – a meaningless term? Pure Applied Chemistry, Vol. 74, pp. pp. 793-807.

Gupta S, Babu BV (2009). Utilization of waste product (tamarind seeds) for the removal of Cr(VI) from aqueous solutions: Equilibrium, kinetics, and regeneration studies. J Environ Manage 90: pp. 3013–3022.

Liu XD, Tokura S, Nishi N, Sakairi N. (2003). A novel method for immobilization of chitosan onto non-porous glass beads through a 1,3-thiazolidine linker. Polymer 2003; 44: pp. 1021-6.

Muhle, S.; Balsam, I.; Cheeseman, C.R. Comparison of carbon emissions associated with municipal solid waste management in Germany and the UK. Resour. Conservat. Recycl. (2010), 54, pp. 793-801.

Schiffman, S.S.; Graham, B.G.; Williams, C.M. (2008) Dispersion modeling to compare alternative technologies for odor remediation at swine facilities. J. Air Waste Manage. Assoc., 58, pp. 1166-1176.

USEPA (2000). Arsenic removal from drinking water by ion exchange and activated alumina plants, EPA/600/R-00/ 088, October 2000.

Zhang, H.; He, P.; Shao, L. (2008). Implication of heavy metals distribution for a municipal solid waste management system - a case study in Shanghai. Sci. Total Environ, 402, pp. 257-267.

Corresponding Author

Nitika Kohli*

Research Scholar, Jodhpur National University, Rajasthan

E-Mail – nitikohli68@yahoo.com