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Study on Impact of Urbanisation on Groundwater Quality of Nagpur City using Remote Sensing and GIS

TAUSEEF A. ANSARI,[1] Y.B. KATPATAL.A.D. VASUDEO

Groundwater availability in most of the urban areas in India seems to be improving due to provision of piped water supply, but the quality of groundwater is becoming a serious concern.Nagpur urban area has satisfactory groundwater availability but the quality is deteriorating in certain pockets and may not be used.In the present study, remote sensing and GIS has been used to estimate the impact due to fast changing urban scenario. Due to the development in the span of eight years, drastic changes in the land use / land cover and the quality of ground water have been observed in Nagpur urban area.High reso satellite images of Nagpur urban area of year 2002 and 2010 are selected for recording the temporal variation in land use/land cover. The total change recorded in the land use area is 75.16 km². The values of ground water quality parameters like Calcium (Ca), Chloride (CI), Fluoride (F), Bicarbonate (HCO_3), Magnesium (Mg), Sodium(Na). pH value, Total dissolved solids (TDS) and Total Hardness (TH) collected from 45 different wells of Nagpur urban area were used for interpolation. The ground water quality maps of 2002 and 2010 are generated in the Are GIS and ERDAS Imaginc environment. Inversedistance weighted (IDW) method of interpolation was applied to all the chemical parameters and the groundwater quality maps are prepared. Each parameter has been weighted based on its impact on human health and weighted sum overlay analysis was carried out to locate the areas in the city where ground water quality has changed. The change has been estimated and compared with desirable limit given by BIS Drinking Water Standards (IS 10500 - 91, Revised 2003). It is found that the quality of groundwater has improved in the eight years but it is still not within the desirable limit.

Key words: Land use/Land cover, Ground water quality, Remote sensing and GIS, Inverse distance weighted method, Weighted sum overly analysis etc.

Introduction

With the population growth, the demand for housing is also increasing. Human will be always adapting to their environmental conditions; for building houses, forming a community, and working. However, sometimes the threat and danger of disaster are being forgotten (Haryana et al., 2013). According to United Nations estimates, the population living in urban areas exceeded 50 % of the world total in 2006 and will approach 60% in 2020 (Shahraki et al., 2011).

Although the world population had historically lived in rural areas (Estoque and Murayam, 2011). Land Use Cover Change (LUCC) is acknowledged as an important driver of changes in hydrology as well as the metabolism and productivity of hydrologic ecosystems (Shoyama et al., 2011). LUCC results from the interaction of human activity (social and economic factors) and natural environmental changes (natural factors) (Qingqing et al., 2012). Land cover change, widely used in different areas, can be used to describe changes in urban settlements and vegetation patterns as an important indicator of urban ecological environments and as well plays an important role in the assessment of human settlements (Peijun et al., 2010), Remote sensing technology provides instruments for monitoring land use and land cover change (LULC) and the development of a coherent categorization of land cover units has been a main focus (Tovar et al., 2013). Satellite Remote Sensing (RS) and Geographic Information System (GIS) have been widely applied in identifying and analyzing land use/cover change. Remote sensing can provide multi-temporal data that can be used to quantify the type, amount and location of land use change (Zhang et al., 2011). Land use changes in a watershed can impact water supply by altering hydrological processes such as infiltration, groundwater recharge, base flow and runofr. For instance, covering large watershed areas with impervious surfaces frequently results in increased surface runoff and reduced local surface erosion rates (Pin et al., 2007). Large amounts of data is required for developing such LULC maps and remote sensing can be a source of accurate, detailed information over large areas. Remotely sensed data and the potential to

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Biosorption Kinetics and Equilibrium uptake of Reactive Red 120 dye onto *Nelumbo nucifera*

G. SARANYA[1], P. SARAVANAN[2], N. NAGENDRA GANDHI[3], M. DHARMENDRA KUMAR[4] AND S. RENGANATHAN[5*]

The ability of *Nelumbo nucifera* plant's stem as a biosorbent for the removal of Reactive Red 120 (RR120) from aqueous solution was studied. Experiments were conducted with the effect of biosorbent dosage (0.2 to 1.0 g/L), pH (1 to 6) and initial dye concentration (30 to 110 mg/L) at batch mode. The optimum biosorbent dosage was found to be 0.2 g/L for dye removal. The maximum uptake of dye was observed at pH 2. Equilibrium dye uptake capacity was found to be increased with increase in initial dye concentration. Batch kinetics and isotherm studies were carried out. The kinetic data was analyzed using the Pseudo-first order and Pseudo-second order kinetic models. The data showed that the Pseudo-second order rate equation was more appropriate. The suitability of the Langmuir and Freundlich adsorption models to the equilibrium data were investigated and it was found that the biosorption data conformed well to Freundlich isotherm model. The Fourier transform infrared analysis was employed to confirm the existence of amine group in *N. nucifera* plant's stem. The surface morphology of the *N. nucifera* plant's stem was exemplified by the scanning electron microscopy.

Key words: *Biosorption, Reactive dye, Nelumbo nucifera, Langmuir, Freundlich*

Introduction

Many industries such as textile, tannery, food, paper and pulp, printing and carpet industries employ dyes and pigments to color their products [1]. A high volume of wastewater is produced in the textile industries [2]. The disposal of these wastes into receiving waters causes damage to the environment [3]. Because of reduced light penetration, dyes may significantly affect photosynthetic activity in aquatic life and may also be toxic to some aquatic life due to the presence of aromatics, metals, chlorides, etc [4].

Several biological, physical and chemical methods have been used for the treatment of industrial textile wastewater including membrane filtration, coagulation/flocculation, sorption, ion exchange, advanced oxidation (chlorination, ozonation), flotation, and chemical reduction. However, many of these technologies are cost prohibitive, especially when applied for treating large waste streams [5]. Adsorption hold promise in the treatment of wastewater, as it is low processing cost, low cost adsorbent and easy to handle [6].

In recent years, several sorbents have been identified as possessing good dye-binding capabilities [7, 8, 9]. Among them activated carbon has been widely used in industry as a sorbent for the removal of colour and the treatment of textile effluents. However, activated carbon is the most widely used as an adsorbent; it is not used in a large scale because of its high cost [10]. For this reason, interest has been recently focused on low-cost and locally available adsorbents such as wheat straw [11], neem sawdust [12], orange peel [13], banana peel [14], water hyacinth roots [15], an invasive macro alga *Sargassum muticum* [16], Peanut hull [17], bagasse pith and maize cob [1].

Biosorption is a process that utilizes dead biomass and/or biomaterial for the removal of contaminants from industrial effluents. In particular, aquatic plants are very promising materials to be used as biosorbents in wastewater treatments because they represent a low cost biosorbent and readily available in large quantities. Dried biomass offers more advantages because it does not require a continuous supply of nutrients and is not sensitive to the toxicity of dyes or toxic wastes. It can also be regenerated and reused in many cycles. Using of dead biomass for the dye removal from aqueous solution is both safe and eco-friendly [18].

Reactive dye is a class of highly colored organic substances, primarily utilized for tinting textiles. They are mostly azo compounds with one or several azo (N=N) bridges having link to substituted aromatic structures. These dyes are designed to be chemically and photolytically stable [19]. *N.*

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The Importance of Direct and Indirect Emissions from Charcoal Fuel Consumption in the Emission Inventory of Restaurant Sector

[a,*] DEEPANJAN MAJUMDAR, [b]ANURADHA CHINTADA, [b] JITESHWARI SAH

Charcoal production is a major source of air pollution and total emissions contributed by charcoal consumption in restaurant sector could be seriously underestimated if emissions during its production are ignored. To support this argument, inventory of direct and indirect emissions of CO_2, CH_4 N_2O, NO_x, SO_2, total suspended particulates (TSP), non methane hydrocarbon (NMHC), CO, black carbon (BC) from charcoal fuel consumption in restaurant sectors in two big cities in India viz. Nagpur and Raipur was prepared for 2010. Emissions from charcoal were compared to that from liquefied petroleum gas (LPG), the major fuel used in this sector. Total emissions of CO_2, CH_4 and N_2O from charcoal combustion and equivalent amount of charcoal production exceeded emissions of same from LPG combustion. Global warming commitment (GWC) of CH_4 and N_2O in terms of CO_2- equivalent emissions were also estimated from global warming potential for various time-horizons. It was found that when emissions from equivalent amount of charcoal production was ignored, total emission footprint of charcoal was underestimated by 9.3-90.1% for various greenhouse gases and air pollutants, especially CH_4, NMHC, CO, TSP and BC. So, it is recommended that emissions from equivalent amount of charcoal production needs to be estimated along with its combustion in restaurants in emission inventories to obtain the actual contribution of charcoal fuel consumption in air pollution.

Key words: *Air Pollution; Atmosphere; Energy; Global Warming Potential; Cooking.*

Introduction

Restaurant sector in India has witnessed high growth in last several years due to growing tourism, increase in income of Indians and increasing trend of dining outside [1]. It is believed that number of people eating outside home is increasing, especially in urban areas [2]. As per a survey by Federation of Hotels and Restaurant Association of India [3], 2.5% of surveyed population dined out once in a week while 1.7% dined more than once per week 2.1 and 5.5% dined once and in a fortnight and month respectively. Most of Indian restaurants can be tegorized under the unorganized sector while organized restaurant market share is only about 16% of the estimated rupees 43000 crore (430 billion) Indian restaurant Industry, which may grow up to 45% by 2015 as per the opinion of National Restaurant Association of India [4].

Fossil fuel, including charcoal combustion generate a variety of air pollutants like CO, NO_x, SO_2, VOCs, PAHs, formaldehyde, particulate matter, black carbon (BC) etc. [5,6,7], apart from greenhouse gases (GHGs) like CO_2, CH_4 and N_2O[8]. As GHGs, CH_4 and N_2O have much higher global warming potential than CO_2 at all time scales, making them extremely important in controlling earth's radiation budget. Further, CH_4 along with non methane hydrocarbons (NMHCs) and CO may contribute to the rise of regional ground-level ozone levels causing damages to human and plant life [9]. A study conducted in New Jersey reported that the main source of particulate emissions may be the charbroiling equipments, with under-fired charbroiling contributing about 84% of this particulate matter[10]. In another study, toluene was found to be the most abundant in charcoal emissions during cooking and carbonyls like formaldehyde and acetaldehyde were found in substantial amounts[11]. Charcoal, being a secondary fuel, leads to substantial and sometimes more emissions of some air pollutants during its production than combustion [12,13]. Pennise et al.[14] had indicated that although carbonization actually creates a fuel of higher quality, inherent inefficiencies in charcoal making processes leads to substantial losses of CO_2 and products of incomplete combustion (PIC) from these processes. In India, charcoal production is undertaken by the unorganized enterprises i.e. enterprises not registered under Small Industries Development Organization of India. In many other countries also, charcoal is made by small groups, mostly unorganized, in rural areas (UNDP, http://www.undp.org/

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Indoor Air Pollution & its Assesment in Lucknow City-The Second Largest City of North India

ALFRED LAWRENCE*1 AND NISHAT FATIMA1[1]

Investigations were carried out during the summer season (March-June2012) to observe the Quality of indoor air by monitoring the levels of some selected air pollutants at 15 different houses covering the urban areas of Lucknow city. Concentrations of CO_2, CO, PM10, PM2.5, SO_2 and NO_2 were monitored simultaneously indoor and outdoor and I/O ratios were calculated. Regression analysis for I/O relationship was performed to assess the contribution of outdoor sources to indoor air quality. Air Quality Index (AQI) for indoor air was also calculated to have an idea about the quality of indoor air and its health outcomes. In collaboration with the medical college doctors of the city, we surveyed 197 persons to find out different diseases/symptoms being faced due to indoor pollution. Results of the study revealed that the average levels of PM10 and PM2.5 were above the permissible limits laid by WHO at densely populated and roadside sites with 189ug/m^3 (indoor- 16lug/m^3) and 227ug/m^3 (indoor-182ug/m^3) respectively. Correlation analysis showed positive results. At sites like Alambagh and Chowk, the indoor AQI ranged very alarming with the value of 302 and 209. Survey results also showed that 46% of urban people suffered from acute respiratory infections like bronchial asthma, headache, depression and dizziness and these people were mostly from Roadside colonies.

Key words: *Indoor air quality, Air Quality Index, survey, Bronchial Asthma.*

Introduction

In India, over the past two decades there has been a rapid increase in urbanization and industrialization in many cities. The urbanization process has both positive and negative effects on Indoor Air Quality in many cities of the world[1]. Hence there is an urgent need to know Indoor Air Quality issues, to share the latest information, to make people aware of the risks of Indoor Air pollution and to let them know how to avoid it. Various regulations and guidelines have been imposed by local governments attempting to limit human exposure to potentially harmful particulate in environment (WHO-http://www.epa.gov/air/criteria.html and NAAQS-http://www.who.int/mediacentre/factsheets/fs313/en/index.html). But these standards are based upon exposure to pollutants measured outdoors. The problem is that in urban environments, people spend most of their time indoors- at home or at work[2] Outdoor pollutant concentrations may not be reliable indicators of indoor and personal pollutant sources[3]. Thus, for many people, the risk to health may be high due to exposure to air pollution indoors than outdoors".

In addition, people who may be exposed to indoor air pollutants for the longest periods of the time are most susceptible to the effects of indoor air pollution like acute lower Respiratory infections'. Such groups include the young, the elderly and physically ill, especially those suffering from respiratory or cardiovascular disease[6]. Research indicates that more than 900 contaminants are present in indoor environment[7]. Burning of fuel in any form largely releases various kinds of unburned or waste product in the environments as Particulate Matter,[8]. Some sources of indoor air pollution in homes are solvents used in cleaning, building materials, paint, radon, allergens, cooking, smoking, plastics, carpets, and biomass burning for fuel or cooking[9-13]. Indoor air pollutant levels are affected by trends in building design and construction practices, such as reduced ventilation rates, more tightly sealed buildings, and synthetic building materials and furnishings. Solvents involved in renovations and painting in homes have been associated with increased risk of general respiratory symptoms for children under 5 years[9]. Many can be respiratory and sensory irritants, carcinogens, developmental toxins, neurotoxins, hepatotoxins, and immunosuppressants, and may cause symptoms that manifest as sick building syndrome[14] According to the WHO report, particulate matter (PM) affects more people than any other air pollutant. Even low concentrations of PM have been related to adverse health effects[15]. Very limited work has been carried out in relation to Air pollution from growing urbanization and its effect on human health in Lucknow city. Population and Pollution are strongly correlated to each other; if population increases so does the pollution [16]. Population explosion, industrial growth and increase in vehicles are the main reason for air pollution nowadays [17]. Lucknow is the capital of the most populated state of Uttar Pradesh, it is the second largest city in northern

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Ecological risk assessment in surface water quality of River Ganga System using HPI vis-à-vis PTEs toxicity

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The aim of this study is to determine the spatio-temporal variation, source identification and pollution index of 11 Potential Toxic Elements (PTEs) in Ganga River water, Uttarakhand, India. The observed concentratios of PTEs were found below the permissible level proposed by BIS (Bureau of Indian Standards) for drinking pupose, except Fe, Mn, and Cd in river water samples during the study period. The higher Heavy Metal Pollution Index (HPI) value was evaluated for monsoon season (40.95) followed by post-monsoon (37.67), summer (6.03) and winter season (3.21) whereas higher HPI (31.46) was estimated at downstream site (site-9) and lower value (15.01) was reported for upstream site (site-1). The overall HPI results were found below the critical index value (100). The Principal component analysis (PCA) along with cluster analysis (CA) was applied to deduce association and to ascertain the main accountable sources of water quality degradation. The high concentration of Fe, Mn and Cd highlighes the geogenic inputs, agricultural and at some places industrial waste runoff in the river water which makes it unsuitable for direct consumption for drinking purposes. Therefore, proper monitoring, follow-up of legislation, are required for the River conservation.

Keywords: Heavy metal toxicity, River Ganga, Uttarakhand, Heavy metal indexing, PCA, CA

Introduction

Water quality is considered to be an important factor for human health, a status of disease and river water quality in a region, mostly affected by both anthropogenic inputs and natural disasters (Kazi et al. 2009; Matta et al. 2018). Surface water pollution with physicochemical and biological factors due to human activities is of high interest in all around the world (May et al. 2006; Ouyang et al. 2006; Noori et al. 2010). River water systems refer to the water naturally exposed to the atmosphere, e.g. lakes, rivers and reservoirs water (Noori et al. 2010). Rivers play a significant role in watershed for carrying-off domestic, commercial wastewater and agricultural run-off, and are one of the most sensitive aquatic bodies to pollutants (Singh et al. 2004; Singh et al. 2005; Wang et al. 2007; Matta et al. 2018a; Matta et al. 2018b). In Indian sub-mainland, the River Ganga system support at least 25,000 types of microorganisms and well-evolved creatures, it fills in as a lifesaver to the populace more than 500 million individuals.

In June 2014, The Namami Gange programme was approved by the Union Government of India as an ecological venture to enhance the effect of abatement of pollution, rejuvenation and conservation of River Ganga. It was the most significant single endeavour on the planet to tidy up a sullied waterway yet did not make any progress concerning contamination control and improvement in stream water quality. The essential reason for a disappointment of Ganga Action Plan might be straightforwardly associated with the ecological administration and arrange which incorporates human-condition connection, and so forth (MoEF, 2009). Human interventions has become a great challenge to the world to maintain ecological integrity and to prevent the unsustainable use of rivers water. Water pollution, construction water diversions, dams, changing in land use pattern, sedimentation, deforestation, chemical toxicity, soil erosion and climate change are causing the major threats to the ecology of Ganga River basin (Sarkar et al. 2010; Sinha 2014).

Human activities are mainly responsible for having an impact on river water quality by emitting vehicular emission, effluent discharges and the fertilizers in agriculture, in addition to the high consumption of water resources (Niemi et al. 1990). Due to which enormous stress in the form of heavy metals, has generated on water bodies, which leads the decrease in water quality, biodiversity and the overall reduction in quality of life for the local population (Herrera-Silveira & Morales-Ojeda, 2009). The regular discharges of municipal, industrial wastewater, agriculture run-off and due to the climate change, all affect the river water quality. However, rivers are the primary freshwater sources for agricultural irrigation, industrial and domestic uses in any region (Yu & Sang, 2003), river water quality is essential factor directly relating to human health and living organisms (Kazi et al. 2009). For that reason, it is vital and necessary to possess authentic information on water quality parameters for remedial measurements and management of pollution.

It is, therefore, necessary to prevent and control water pollution and to implement regular monitoring programs. For

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Adsorption of Formaldehyde from Using Bone Char Modified with Acetic Acid

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The aim of this study was to evaluate the adsorption performances of modified bone char (BC) with acetic acid for formaldehyde removal from polluted air. The porous structure, surface characteristics and functional groups involving in the formaldehyde adsorption were analyzed using Brunauer-Emmett-Teller (BET), Scan Electron Microscope (SEM) equipped with energy dispersive X-ray (EDX) and Fourier transform infrared spectroscopy (FTIR) analysis, respectively. It was shown that the modified BC yielded specific surface area and pore volume higher than that of the original BC. The maximum values of the BET for BC and modified BC were 105.24 and 118.58 m^2/g, respectively. The FTIR spectra of modified BC before and after formaldehyde adsorption indicated that the bands associated with the hydroxyl and carboxyl groups of BC surface, played a significant role in formaldehyde adsorption onto modified BC. Moreover, the results showed the breakthrough, equilibrium time and adsorption capacity of modified bone char were longer than that of BC. With the increase of formaldehyde concentration from 20 to 200 ppm, the adsorption capacity (as mg/g) increased from 154.43 to 275.78 for formaldehyde adsorption. It seems the adsorption capacity of modified BC for removal of formaldehyde depends on both physical and chemical properties. These results showed that the modified BC can be used as an efficient adsorbent for formaldehyde removal.

Key words : *Bone char, adsorption, formaldehyde, air*

Introduction

One of the common industrial chemicals that is used for production of more complex compound is formaldehyde (11C1-10). Formaldehyde extensively has been used for producing building materials such as pressed wood, wallpaper, paint[1]. The formaldehyde produced from industrial activities can be emitted for a long time after its production. People mostly exposed to the formaldehyde by inhalation report headaches, sensory annoyance, difficult breathing and asthma symptoms[23]. Moreover, formaldehyde has been categorized as a human carcinogen by the International Agency for Research on Cancer (IARC) and as a probable human carcinogen by the other health related organizations[4]. Formaldehyde, known as one of indoor volatile organic compounds (VOCs), exists in recent building and household product. Therefore, it seems the purification of ambient air containing formaldehyde is essential for improving indoor air quality and human health[5]. Several engineering processes are used in industry to remove VOCs such as formaldehyde from ambient air[6]. These techniques are categorized in two wide groups: oxidation method and recovery method. Oxidation methods can convert the volatile organic compounds into non-toxic matters such as carbon dioxide and water. This method has several disadvantages such as difficulty of VOCs recovery from air, expensiveness and energy demanding. In the case of the recovery methods, the recovery of organic solvents with energy saving and considering environmental aspects are practical. The recovery methods include adsorption by solid sorbents, absorption by liquid sorbent, ion-exchange, condensation and membrane technology[7]. Among these methods, the adsorption method is considered as the most promising method for recovery of volatile organic compounds. With regard to effectiveness and simplicity, the adsorption method can be used for formaldehyde removal[3], because it is selectively possible to uptake adsorbate via pore structure of adsorbent. Whereas in adsorption process, characteristics of adsorbate and also adsorbent determine adsorption efficiency. Therefore, the selection of the suitable adsorbent is very critical. There are different materials that can be proposed as adsorbent for removal of organic pollutant[8]. The carbonaceous adsorbents such as activated carbon were extensively utilized to remove organic pollutants from air [9]. However, it was demonstrated that the activated carbon produced from conventional source can't efficiently remove the formaldehyde vapor from air. Among the materials used for adsorbent synthesis, BC has been widely used for removal of different pollutants from drinking water[10,11]. It has recently been proposed that poorly crystallized apatite, such as bone char, can be used as an effective adsorbent because of its low-cost and availability[12]. A large number of animals have a large

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