Chapter II

2.1 Adsorption Kinetics Studies:

In the present investigation attempts have been made low-cost-efficiency of adsorbent material is made by the locally available.

Deals with the synthetic waste water containing chromium (viz inorganic pollutants (VL) and cadmium (LL) ions, adsorbent from Datura stramonium. -The plant Datura stramonium, the Solanaceae family) adsorption kinetics was made on the basis of the dose modification, and pH and contact.

2.1.1 Preparation of activated carbon from Datura stramonium (ACDS):

The naturally dried stems of course, the dried stalks the Datura plant stermonium locally produced. The carbonization was first exposed to a known process fixed carbon dioxide was formed, which then activates the heat stream (200-1600 in Highlight Tone °C). Washing the phosphoric acid, zinc chloride, etc. ) activate. Cut the small pieces. The stem is also concentrated sulfuric acid (for five times in the oven and kept for 24 hours 150 C . This was filtered and washed with distilled water several times to remove sulfuric acid (washing two drops of the barium chloride solution) and finally dried. The adsorbent was filtered the 40-60-inch size, and the 150 C for 2 hours.

The physical characteristics of adsorbent, like particle size, pH solubility in water, solubility in 1NHCl and density are 40-60, 7.0, nil, nil and 0.431 respectively.

In order to have waste of uniform characteristics and to avoid interferences of other element the synthetic wastewater was prepared this is called stock solution.

The adsorbent the physical properties, as well as the size,pH 1 solubility in water solubility NHCl ,and the density 40-60,7.0 ,zero - zero and 0,431 .

In order to ensure that the uniform and the other in order to avoid interferences is made of a synthetic waste this stock solution.
2.1.2 Potassium dichromate Cr (VI) solution: 2.82g AR quality potassium dichromate split off 1000ml of distilled deionized water and acetic acid. This solution was the dark brown-colored glass bottle and the stock solution.

Cd (II) Solution: The stock solution (2 mg/ml) was prepared CD (A3) 2.4 H2O (E) to the 0.1 M HNO3 FOR. The solution a single complexometrically-disodium salt) xylenol (orange light.

The trials were carried out in batch mode, the adsorption capacity. In bottle filled with 250 ml water bottle on the adsorbent to separate and and at room temperature in a electric mixer 500 rpm and the required time period. The adsorbents and the solution by centrifugation. The solution analyzed by UV-VIS spectrophotometer.

Bach's completion of the test adsorption studies the effect of pH (2,3,4,5,6 and 8.), Partner (15-150 minutes), adsorbent dose (serial mode 2 to 18g/l), and the initial metal-ion concentration (40-150 inch mg/l) at room temperature the plug. PH of the solution will use was the first 0.05 or 0.1 N NaOH N HCl, without the sample volume. The required contact time the agitation, the content is filtered through a Whatman centrifuge, then no. 41 filter paper and it did not react and chromium cadmium (separately) in the worke spectrophotometrically ions was analyzed.

The removal efficiency (E) the adsorbent are defined by:

This

\[ E (\%) = \frac{C_O - C_E}{C_O} \times 100 \]

If the \( C_O \) and the \( C_E \) metal ion and equilibrium concentration (mg/l) respectively.
The Results are as follows:

It was not a significant increase from the chrome 105 min 120 min and the cadmium, after this time will continue to grow was very small. Thus, the effective exposure time (equilibrium) to 105 minutes for the CR (VL) and 120 minutes for the CD (LL).

It was found that 93.9 % and 93.4 % for CR (VL) is available for phase 2 and 3 percent, and there is reduced from the pH value increases, the 4,5,6 ,and 8. Thus, the optimal pH-adsorption Cr (VL) down to 2. But the same absorbent and CD (LL) adsorption was valid the pH 6 (77.8 % ). So chromium and cadmium adsorption effective phase 2 and 6. The effective dose both metal-ion has proved to be 15 g/l.

The results show that for the lower initial concentration (40 ppm, 60 ppm), the efficiency is 94.9 % was higher, 77.8 % chromium cadmium concentration of 40 ppm.

Adsorbate adsorbed at the adsorption capacity per unit mass of absorbent name. Absorption to increase the initial concentration studied the adsorbate. Experienced the maximum adsorption capacity: 30 mg Cr (VL) /g acds with status and 25 mg CD (LL) /g acds with status.

2.1.3 Adsorption isotherms:

Four isotherms, see below the eq.1-4 the experimental data were 33 °C measured

**Freundlich adsorption isotherms**

\[ Q_E = \log \log n \log Kp + 1/C_E \]

1.

**Langmuir isotherm**

\[ C_E/QE = 1/Qmb +ce/Q_M \]

2.
Dubinin-Kaganer -Radushkevich equation (DKK)

\[ \ln \ln q = Xm - S2 \]  

**Temkin equation can be calculated as follows:**

\[ QE = +2.303 \log C_E \]  

The Langmuir and Freundlich isotherm \( C_R \) (VI) and \( C_D \) (II) it was found that the isotherm the linear presentation. 2,5549 Was the value of \( n \), the \( C_R \) (VI) and1.9149 \( C_D \) (II) the effective dose and contact time indicates good adsorption capability acds with status. The \( R_L \) and the adsorption more favorable. The 0,0674 was the \( R_L \) 40 ppm Cr (VL) and 0,200064 40ppm/C_D (II) solution.

Parameters of the DKK slop the adsorption capacity (Xm) in the acds with status 5,9518 mg/g of \( C_R \) (VI) and 4,7185 mg/g \( C_D \) (II). The energy value 6,0861 kJ/mol Cr (VI) and 1,995 kJ/mol for \( C_D \) (II) in the acds with status.

Here is the model of the current data to the acds with status about the Freundlich isotherm>Langmuir >: Temkin> DKK to \( C_R \) (VI) and the \( C_d \) (II) Freundlich > Langmuir>Temkin> DKK.

The adsorption kinetics measurements that metal-ion concentration 40.60 and 80 ppm optimal pH-value. Concentrations of the metal-ion was measured UV-VIS spectrophotometer.

Depending on the experimental adsorption data are used for kinetic modeling. The used equations are as follows:

- Because equation 1 can be calculated as follows:
  \[ K1 = 2,303 / t \text{ CO /CO-CE} \]

- Lagergren equation can be calculated as follows:
  \[ \log (Qe (q)) = \log QE - \text{unharmed t/2,303} \]
• Second-order can be calculated using the equation:

\[
\frac{1}{C} - \frac{1}{C_0} = k_2t
\]

• Pseudo second order equation can be calculated as follows:

\[
\frac{1}{(Q_e - q)} = \frac{1}{Q} + K
\]

• Simple Elovich model:

\[
Q = \text{the} + 203.03 \cdot b \log t
\]

• The function equation:

\[
Q = \log a \log + \log b \cdot t
\]

The CR(VL), adsorption experimental data pH2 and CD(ii) adsorption experimental data (6), the kinetics of pH linear regression modeling.

The current Cr(VL), whose concentrations 40, 60, 80, the initial pH 2. It was tested on experimental data to the kinetic modeling linear regression. The linear regression \((R^2 > .95)\) the kinetics of CR (VL), adsorption acds with status can be written good Lagergren equation \((0.9604, 0.9556, 0.9798)\) equation \((R (2), \text{power function} = 0.9714, 0.9559, 0.9754)\) equation \((R2, \text{simple Elovich} = 0.9781, 0.9676, 0.9634)\). The results clearly show that the three model fits well progressively increasing adsorbate concentration. Moreover, it was found that the experimental data, 40ppm Cr (VL) solution fits well, also to the equation \((1) (R2 = 0.9389)\). Lagergren equation, the function equation and simple Elovich equation is obeyed, and the lowest concentration adsorbate studied it.

In the same CD (LL), whose concentrations 40, 60, 80.6 phase. Lagergren can be calculated using the equation \((0.9729, 0.8876, 0.9643)\), power function \((R2 = 0.9813, 0.98, 0.9796)\), simple Elovich equation \(r2 = (0.9863, 0.986, 0.9788)\).
The adsorption rate constants (k) in the metal ions reduce the concentration of metal ions increases. Other words, the rate of adsorption corresponding decline the adsorbent.

Analyzes indicate that the various kinetic model parameters between the experimental adsorption data are mainly a model for other more and more initial adsorbent concentration.

The intraparticle diffusion rate constants (Kid), chromium (VL) and CD (LL) in various doses. Pore diffusion rate constants (D), chromium (VL) was found to be 0.0699 and the CD-ROM (LL) 0,0552 40 ppm concentration. The diffusion rate parameter indicates that the intraparticle diffusion controls the sorption value that the slowest step of adsorption. The values are increased with an increase in the dose level.

It was the purpose of the chapter to remove the CD-4 (ll) waste water adsorbent of artificially produced a new polyvinyl alcohol coated carbon the *Datura stermonium*(PVA-DS).

The PVA broke 1 10ml of hot water in the gel formation occurs. The furnace black now 2.5 is added to the form a thick paste. This is a joint active carbon the *Datura stermonium*. It was now the thick paste is obtained and then form of dried fruit. Fine dust the soil. This port is a absorbent material.

It is concluded that the CD (ll) synthetic waste water adsorption by the adsorbent PVAC-DS has proved to be: useful for water pollution-CD (LL). PVAC-DS exhibits high CD (LL) efficiency and industrial waste may be the CD-ROM (LL). The CD (LL) archive 77,8 % was the PVAC-DS DS, however, 84,7 % respectively.

The treatment is the as to minimize the operating costs of the contact time should be small as possible for reasons of efficiency, the contact time limiting factor cost item, here in 84,7 % OF CD (LL) was removed, as it was 105 minutes, and then the Party less time is required.
5. Chapter II deals with the treatment is the artificial water sample ink (Bordeaux) adsorbent adsorption method from *Salvadora persica*. Adsorption kinetics in the light of the examination of change has been made the dose levels, pH and contact time. *Salvadora persica*, family *Salvadoraceae*.

A comparative study of the Bordeaux (B the two adsorbents i.e. active carbon the *Salvadora persica* (ACSP), POLYVINYL alcohol coated carbon (PVAC-SP) for the different pH-s type no absorbent material to study.

The % of the was found in 69.9 % and 95.7 % and of the ACSP process, and PVAC-SP, or to the balance to contact time of 90 minutes.

The pH of the solution The ionization degrees and in turn affect the rate of adsorption. B of the Bordeaux was 69.9 % and 95.7 % ACSP PVAC-SP equilibrium pH-time is 8.

ACSP process when it is noticed that 90 minutes. (40 PPM) efficiency differs by 54.2 % of the 71.7 %. About the same efficiency (71 %) was less than a PVAC portion-SP 6g/l with 120ppm concentration with paint. The % of Bordeaux from B, it was found that the adsorbent increases more and more dose up to 15 g/l, above the. Thus, the effective dose to the adsorbent was considered as 15 g/l. This is the result showed that PVAC-SP right adsorbent and ACSP process. The effective adsorbate concentration is in the dye of 40 ppm.

The PVAC the n, 1,9357 was the ACSP-SP 2,8384 the effective dose and contact time was the garter PVAC-SP and ACSP process, indicates the PVAC good adsorption potential-SP. It is also the RL and the adsorption of more favorable PVAC-SP and ACSP process.

The obtained equation shows that the DKK adsorption capacity (Xm) the PVAC was 5.87mg/g, which is greater than ACSP process at 4.49 mg/g. Here it is for the isotherm data models follow broadly ACSP process: Temkin>Langmuir>DKK> Freundlich and PVAC-SP Temkin>Langmuir> Freundlich>DKR.
PVAC-SP may be what the paint or other metal ions to waste water.

Among the most important benefits of biosorption traditional methods of treatment; · low cost high efficiency; · minimize chemical and biological sludge; · low demand the additional nutrient regeneration; · the biosorbent; and · the metal recovery possibility. The effluents adsorption of heavy metals is rising is very efficient, inexpensive, and simple process. PVAC-SP may be what the paint or other metal ions to waste water.

2.2 ADSORPTION EQUILIBRIA

Adsorption processes usually precedes the different mechanisms such as the external mass is the mass of the dissolved substance intraparticle mass followed by the sorbent. If wide-scale experimental data is available on the special adsorption, the rate-determining step control is not possible. Therefore, empirical design procedures based on adsorption equilibrium conditions, the most common method is the absorber size and performance. Adsorption equilibrium is reached, if able to absorb a dynamic concept of the molecules on a surface of equal proportion they desorbs. The physical chemistry there may be complex, and not to a single theory of operation the adsorption has been comment on the systems. Fortunately, the engineer only the equilibrium conditions. Even now the oldest predict the sorption process theory, even when the models in question was a lie in later years is not completely valid. Most of the adsorption theory was developed at the gas solid systems, because the things, as the fluid. Until now the statistical theories have been developed for gas-solid systems are the liquid solid systems are designed and little confidence. The most commonly used models for a equilibrium Freundlich adsorption systems, which Langmuir isotherm equation:

2.2.1 Freundlich isotherm:

Herbert Freundlich Max Finley, the German physical chemist, an empirical adsorption isotherm is not ideal for sorption of heterogeneous surface, and the tiered sorption and expressed as the following equation:

\[ QE = K_f C_e^{1/n_f} \]
Equation (2) calculation of the equilibrium concentration of residual dissolved material weight (CE) in a given quantity of waste water containing dissolved particles mass of adsorbent material/quantity of (Vo/xo). Experimental data on CE and Qe values were compared. Adsorbing batch reactor could be considered as an ordered equilibrium and it depends on the balance two basic constraints and a mass balance.

2.2.2 Langmuir Isotherm:

The general equation is a heterogeneous reaction (adsorption), more than a process. Two of the main processes heterogeneous systems physical (heat and weight) and reaction. For example solid reactions catalyzed by catalytic converter, and the process began a bond the first rupture of molecules, and then the new James Bond, but in this case the chemisorbed molecules previously surface of the catalytic converter. This is the physical transmission process (chemisorption) appearance depends on the reaction of molecules and atoms of "co-ordinatively unsaturated active sites" for solid surface, elementary steps is considered to be the reaction mechanism. These ratios global or fully and their application will allow us to design the most. It participates in the international were to the systems are designed with the predicted rate constants corresponding to each step that the entire process occurs. The sequence of steps convert reactants the product concerned.

- Transport of reactants in bulk liquid in the liquid-solid interface (external surface of the catalyst particles).
- Intraparticle transport of reactants upstream of the catalytic converter (if porous).
- The internal adsorption reactants the catalyst.
- Chemical reaction of adsorbed reactants adsorbed (surface reaction - the internal chemical step).

2.2.3 Desorption of adsorbed products:

- The transport of the products inside the outer surface of the pages.
- The transport of the products the liquid into the raw liquid surface.

The Steady State rate each step will be the same. For the promotion of equality between design allows the global equation for the concentration and the total temperature of the fluid. If a vague public behavior exiss and will contribute to the global rate of the slowest step in order to apply the design equation. This bulletin in
the operating principle of the explanation of heterogeneous reactions on the principle of operation behind adsorption reactions. The reversible to a single species, which still remains the same (undissociated) adsorption may be represented by

$$\frac{K_d}{A + S} \rightarrow \frac{A}{S}$$  \hspace{1cm} (3)

The adsorption, proportional to the speed hit the surface of a molecules, the raw is proportional to the concentration, and the free places.

$$Ra = s \left( CA \ 1 - \ \theta A \right)$$  \hspace{1cm} ... 4.

Where s the adsorption constant. (4) if a molecule only sensible mass to the solid surface, as long as the $t = 0$ and $t = \theta$. Similarly, the desorption, rd is proportional to the surface, the surface $\theta A$:

$$Rd = Kd\theta A$$  \hspace{1cm} ... 5.

If the desorption Kd standing.

The adsorption equilibrium exchange rate is equal to the desorption, $Ra = RD$.

It is therefore

$$KaCA \ 1 - \ \theta = Kd\theta A$$  \hspace{1cm} ... 6.

(6) Equation by rearranging the fraction solid particles down

Based on these equations is based on the assumption that the surface is not smooth and continuous is also a molecule only occupies a keeps a clear space, and this assumption is also the catalytic reactions. That is, the enthalpy of the molecule was the whole active sites. But there was no homogeneous surface particles the chemical systems (up to or without an answer), that even the sanded surface rough surface shows the microscopic scale. This limitation shows the Langmuir model. This model also suffers due to the background only occurs in the reaction mechanism solid liquid reactions and do not consider it a liquid, solid liquid interactions.

2.2.4 Isotherm shape:

The equilibrium curve Qe and CE also defines the nature of particular process. Show the shape of the curve the process shown in figure 2.
2.3 ADSORPTION SYSTEMS:

The solid and the liquid absorbent is also at least five systems:

His bed on the lot (fixed or down flow), pulse-bed, bed, and fluidized bed under steady-state motion.

3.3.1 Batch systems.

Batch systems must be used, if the quantity of treated waste water. The different parameters on the sorption will take into account the item shown in figure 2. If G kg solvent and concentrations of pollutants will be reduced (1), kg Yo Y / kg mass of the substance dissolved in solvent. The adsorbent is inserted at the end of the L kg free adsorbate solid and dissolved the mass of the substance concentration is increased, the xo-X (1) kg mass / kg. If fresh adsorbent, xo = 0. It will be a mass balance taking into account.

\[
G(y_0 - Y_1) = L(X) = (1), - xo-LX1 \quad \ldots \quad 7.
\]

Given by the Freundlich isotherm equation (8) shall be applied (7):

\[
Qe = KpCe^m/NF \quad \ldots \quad 8.
\]

If, Kp, NF, Freundlich are dependent on. The equilibrium concentration of a dissolved substance XE mass (kg) (kg) of the adsorbent and ti equilibrium dissolved material weight.
\[
L (T/KF)^{1/nf} = G (Y)
\]

(8) substitution equation of equation (7), (9):

(9) calculate the adsorbent ratio using the solution in a particular change to the concentration, (well).

2.3.2 Fixed Bed Adsorption:

Batch sorption type in general, only small quantities of waste-water treatment, whereas the advantage has decided the restriction bed systems. The fixed bed the adsorbate is the connection to the given quantity of fresh adsorbent thus providing the necessary concentration gradient is the adsorbent adsorption and adsorbate. Although a lot of methods are available the adsorption column in the practical general method in the bed adsorption column depth planning service (BDST) model. The planning, design and theory of operation the bed adsorption systems centers design the revolutionary wave, and the flow rate in bed.

2.3.3 Steady State Moving Bed Adsorption:

The moving bed adsorption column countercurrent operation a stable status is continuous motion since the adsorbent is below the column down the liquid is flowing upwards. This common method of operation and the most widely used in most wastewater treatment plants.

2.3.4 Fluidized Bed:

If the adsorption process, that it is advantageous to as small as possible. The adsorbent is achieved greater adsorption. The smaller particles from a adsorbent bed fixed problems, such as the excessive head loss, binding in its entirety and against dust as the benefits of this can be resolved in accordance with the fluidized bed systems. The fluidized bed system, there is also a benefit to larger mass transfer rate adsorbate and adsorbents. Mainly in the design of the fluidized bed includes the determination of mass transfer factor; \(K\).

2.3.5 Fixed Bed Adsorber Design:

Different models are available in the stationary bed adsorption column, MTZ, HETU BDST model and discussed the most frequently used the following:
(a) **Zone model weight (MTZ MTZ model):** the concentration of dissolved material weight varies the adsorbent CO value the initial equilibrium value CE. The area under the curve reflects the first is not used the adsorbent.

(b) **Bed depth time:** the continuous attempts, it is essential that the exhaustion of the adsorbent bed time how long it takes before the regeneration is necessary. This method in the fixed bed adsorber a solution that can be given a single adsorbate, the operational variables

So against the service always put him to bed depth can be used to test the model.

(c) **The same transmission unit height:** This is the column design method is based on the same transmission unit two concepts: height and at the maximum total adsorption takes place.

2.4 **LOW COST ADSORBENTS:**

The most important methods, which have been utilized to reduce the heavy metal ions, the content of waste water, inter alia, lime, ion exchange, adsorption to activated carbon (Dean et al., 1972), a membrane and electrolyte (Braukmann, 1990). These are the methods for the limited, because they are often large investment and operating costs, and reduce the generation of secondary waste problems, which is currently, such as the large quantities of sludge generated by processes. And ion exchange, reverse osmosis and adsorption processes may be also due to more attractive along the metal values recovered and the waste. Reverse Osmosis and ion exchange does not appear to be economically viable in the relatively high investment and operating costs. By adsorption are the advantages of the other method for simple design, sewage sludge may be free environment and low investment costs and the first two terms for land (Viraraghahan et al., 1993). They are extremely effective activated carbon adsorbent in heavy metal ions of concentrated and metal bearing (Netzer and Hughes, 1984; Reed and Arunachalam, 1994). But the process is not used for the small to medium-sized industrial waste water treatment, because the metal bearing the high cost of production. For this reason, it is a low-cost materials, which are the metal-ion-adsorbent for waste water has been highlighted. If, however, efforts have been made to repair and absorbent it has contributed to the development of new products to existing adsorbents to alternative the activated carbon. These are the materials for the
industrial products and the rubber tires (Knocke within. Hemphill, 1981), the industrial wastes and also some agricultural product natural material and product.

In order to overcome the problems, and the amending chemical raw adsorbents are required. The various agricultural products and by-products of heavy metal solution to the number of authors have been tested. The obvious advantage of the other method is cheaper organic waste materials available are used to summarize the literature table 3 shows that these are not good covenantal adsorbents have heavy metal adsorption capacity of the industrial waste water. The metal adsorption capacity (in mg/g) and a by-product of agricultural product is compared with active carbon and ion exchange resin a cat (table 4).

5. Table summarizes the possible more low-cost adsorbents for different pollutants, such as the color, heavy metals, COD of waste water. Although several studies explain the low-cost adsorbents, use more in most cases, these laboratories and is the only in a very few cases will be implemented directly in the practical applications, industrial level.

**Table 2 Treatment of Different Wastewater by Adsorption**

<table>
<thead>
<tr>
<th>S. Do not.</th>
<th>Authors</th>
<th>Adsorbate</th>
<th>Adsorbent</th>
<th>Variables studied</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sekar Murthy and. (1998)</td>
<td>Wash the distillery spent</td>
<td>Powdered activated carbon</td>
<td>Initial conc., adsorbent dosage.</td>
<td>The 18 % must be taken into account, when he was exhausted, a polyelectrolyte pretreated flocculating agent, the color was up to 99 % increased.</td>
</tr>
<tr>
<td>2</td>
<td>Bit keen, aren't yeh and Thomas (1995)</td>
<td>Unlock a synthetic dye waste-red-60&quot;</td>
<td>Powdered activated carbon</td>
<td>The contact time the PAC is for it.</td>
<td>95-98 % COD removal with the 25-200 ppm - 88-98 % of various particles. Freundlich, Langmuir adsorption isotherm, Dziubek &amp; Kowals fits well. Film-pore double resistance diffusion model describes how the crowd. The outer foil weight coefficient of increases in a decrease in the particle size.</td>
</tr>
<tr>
<td>3</td>
<td>Bit keen, aren't yeh and Adrian Thomas (1995)</td>
<td>Disperse the red-60&quot;</td>
<td>Powdered activated carbon, activated, molecular filter + kieselguhr</td>
<td>Time, adsorbent dosage, the particle size</td>
<td>Only a minor decrease in particle size improvement from the activated molecular sieve material, the finer the fed reduces defensive party. Adsorbents's performance in the PAC-t&gt; activated&gt; molecular sieve.</td>
</tr>
<tr>
<td>4</td>
<td>Mahesh et al. (1998)</td>
<td>Catechol</td>
<td>Granular activated carbon; Laboratory quality] [industrial use</td>
<td>Initial concentration, pH, adsorbent dosage, the particle size.</td>
<td>Equilibrium IGGAC studies have shown that the maximum adsorption capacity. Diffusion test showed that the initial part of the impact of external</td>
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</table>
weight intraparticle diffusion to follow.

<table>
<thead>
<tr>
<th></th>
<th>5 Kapadia et al (2000)</th>
<th>Chemical (raw)</th>
<th>Coal fly ash</th>
<th>Initial concentration, contact time, adsorbent dosage</th>
<th>Adsorption dose 3-3.5 % significant color. The optimum provides a connection between 30 - 40 minutes.</th>
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<tbody>
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<td></td>
<td>Studies show that it also reduces flyash lot, ammonical suspended solids, COD, and nitrophenol apart from. The adsorbents descending PAC&gt;carbon soot&gt;granular activated carbon (GAC)&gt;Flyash.</td>
</tr>
<tr>
<td>No</td>
<td>Author(s)</td>
<td>Dye(s)</td>
<td>Adsorbent(s)</td>
<td>Parameter(s)</td>
<td>Result(s)</td>
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<tr>
<td>7</td>
<td>Shopping Center and Upadhyay. (1998)</td>
<td>Malachite Green and methylene blue.</td>
<td>Fly ash (I) &amp; (II)</td>
<td>Initial concentration, contact time, adsorbent dosage, the bed height.</td>
<td>Flyash containing the color had to be reached so that high carbon dioxide content. The column displays the BDST studies theory.</td>
</tr>
<tr>
<td>8</td>
<td>Sharma et al (1999)</td>
<td>Malachite Green</td>
<td>BAGASS E peel, orange peel, sawdust, Eichornia shoot &amp; root</td>
<td>The original dye conc., initial adsorbent dosage - Ph</td>
<td>PH tests show that there exists a type of chemical interaction and adsorbate adsorbent. Eichornia Efficiency in descending root&gt;Eichornia create&gt;orange peel&gt;sawdust&gt;bagasse.</td>
</tr>
<tr>
<td>9</td>
<td>Nassar and Geundi (1991)</td>
<td>Astrazone Maxillon blue, red, blue Telon.</td>
<td>Activated carbon, natural clay, bagasse, Corn cob.</td>
<td>Initial concentration , adsorbent dosage.</td>
<td>Active carbon maximum adsorption capacity. Analysis of costs has shown that natural clay, bagasse peels &amp;Corn cob was economically</td>
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<tr>
<td>1</td>
<td>Balasubramani m et al (1998)</td>
<td>CR (IV).</td>
<td>Lignite</td>
<td>Adsorbent dosage.</td>
<td>Lagergren application area or kinetic model has shown. They tend to follow the patient information are described in the first level of item.</td>
</tr>
<tr>
<td>12</td>
<td>Sankar et al (1999)</td>
<td>Direct red 31, blue-black, 1 &amp; (16</td>
<td>Rice bran-based activated carbon</td>
<td>Time, temperature, concentration, particle size</td>
<td>I saw the the acid pH and 20 - 30 degrees C the enthalpy value shows that the physical adsorption phenomena</td>
</tr>
<tr>
<td>13</td>
<td>Nassar and Magdy (1999)</td>
<td>Simple red 22</td>
<td>Natural clay</td>
<td>Initial concentration, adsorbent dosage, and</td>
<td>Bulk data transfer Thar study has shown the external mass transfer only</td>
</tr>
<tr>
<td></td>
<td>Authors</td>
<td>Initial Concentration, PH, Adsorbent Dosage, Contact Time, Mixing Speed.</td>
<td>Initial Concentration, pH, Temperature, Adsorbent Dosage.</td>
<td>The Temperature of One of the Most Obvious Weight.</td>
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<td>14</td>
<td>McKay and McConvey (1981)</td>
<td>Blue Astrazone Charred wood</td>
<td>Bulk data transfer</td>
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<td>Thar study has shown the external mass transfer only the control.</td>
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<td>15</td>
<td>McKay and Allen (1980)</td>
<td>Telon blue (acid) Peatv</td>
<td>Second was a pseudo-device.</td>
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<td>16</td>
<td>McKay and Ho (1998)</td>
<td>Blue BG Astrazone Peat</td>
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<td>17</td>
<td>(1997) and V. Krishnan Annadurai</td>
<td>Red Verofix Chitosan</td>
<td>The patient describes the followed by first-order kinetics</td>
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<td>18</td>
<td>Inbaraj and Sulochana (2002)</td>
<td>Malachite Green Jack fruit peel (charred chemical method)</td>
<td>Shall endeavor to follow equilibrium Freundlich, Langmuir isotherm are sent to &amp;</td>
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<tr>
<td></td>
<td>Authors</td>
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<td>Results and Findings</td>
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<td>19</td>
<td>DAS, Patnaik (2001)</td>
<td>The paper mill processes with sewage is Blast furnace slag dust and First COD conc., pH, temperature, ph-value.</td>
<td>Redlich Peterson. Other studies show that the chemical adsorption phenomena.</td>
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<td>20</td>
<td>McKay (1982)</td>
<td>Yellow, Blue, blue Victoria Deorlene Telon. Active carbon</td>
<td>Initial conc., pH, particle size, adsorbent dosage, with salt. Batch test shows that the salt from the Naso (4), increases the rate of adsorption.</td>
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<td>21</td>
<td>McKay (1982)</td>
<td>Yellow, Blue Deorlene Telon. Active carbon</td>
<td>Bed height, the particle size. The column displays the BDST studies theory.</td>
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<td>22</td>
<td>McKay (1983).</td>
<td>Telon Deorlene blue, yellow, blue Victoria, to blue Active carbon</td>
<td>Adsorbent dosage, the particle size, the initial conc. Diffusion diffusion test shows that it is not the intraparticle volume control.</td>
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<td>23</td>
<td>McKay (1983).</td>
<td>Telon Deorlene blue, yellow, blue Victoria, to blue Active carbon</td>
<td>Adsorbent dosage, the particle size - Initial conc. Mass tests show that the external mass transfer are mainly controlled by initial concentration and</td>
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<td>#</td>
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<td>Initial Conc.</td>
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<td>24</td>
<td>McKay (1984)</td>
<td>Telon Deorlene blue, and yellow</td>
<td>Active carbon</td>
<td>Initial conc.</td>
<td>A homogeneous solid-phase diffusion coefficient to estimate the two weight would have been.</td>
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<td>26</td>
<td>Kapadia et al (2000)</td>
<td>Copper (synthetic)</td>
<td>Fly ash</td>
<td>Initial conc.</td>
<td>It was with maximum effectiveness of pH 6.0. The fly ash waste water treatment increases in the pH of</td>
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<td>Metal</td>
<td>Adsorbent</td>
<td>Condition</td>
<td>Notes</td>
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<td>28</td>
<td>RAO et al (2001)</td>
<td>Copper and lead (synthetic)</td>
<td>BAGASSE, fly ash</td>
<td>Particle size, adsorbent dosage, Initial conc., pH.</td>
<td>Decrease in the adsorption capacity ash &gt; bagasse &gt; PAC from the PAC &gt; bagasse &gt; copper ions and the lead ions fly ash optimal conditions.</td>
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<td>29</td>
<td>The ET AL (2000)</td>
<td>Magenta</td>
<td>Rice cup fly ash (boiler)</td>
<td>Initial conc.</td>
<td>If compared with the other adsorbents has dodged the maximum adsorbent possible, nickel shows better needs dodged adsorption sites.</td>
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<td>30</td>
<td>Viswanathan</td>
<td>Zinc-nickel</td>
<td>Dodged, PH, particle</td>
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<td>If compared with the</td>
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et al.  ions  sawdust, clay, fly ash  size, the initial conc., calcium-ion.  other adsorbents has dodged the maximum adsorbent possible, nickel shows better needs dodged adsorption sites.

2.5 ADSORBENT REGENERATION

The regeneration process is an important consideration, because one is generally a exothermic process, the higher temperatures are not supported and this would be beneficial to the regeneration process. This may not include or only to a limited extent the surrounding liquid adsorbate raised the temperature in the adsorber will drive off the adsorbate. This method of regeneration is called "to swing adsorption (" (CO. on). Two other common methods, "pressure swing adsorption (PSA) and the "Transport purge adsorption" (DPA). The PSA, the adsorption is generally high-pressure and lowering the pressure in bed in the regenerate in bed. This is the advantage of a Co. on is passed to the faster regeneration, faster. The adsorber the DPA first saturated with easy-to-adsorbate the desired adsorbate. The decision to "Regenerate particle filter" the adsorbent bed the "revolutionary" point. The breakthrough point to the maximum permissible concentration of the adsorbate gases exit the fuel vapor canister) shall be determined by the breakthrough curves.
CHAPTER CONTENT

Chapter -3

1. Methodology
2. Materials and Methods
3. Observations
4. Adsorption Isotherms
5. Results of Isotherm Models
6. Adsorption Kinetics
7. Intra-particle diffusions
8. Conclusion