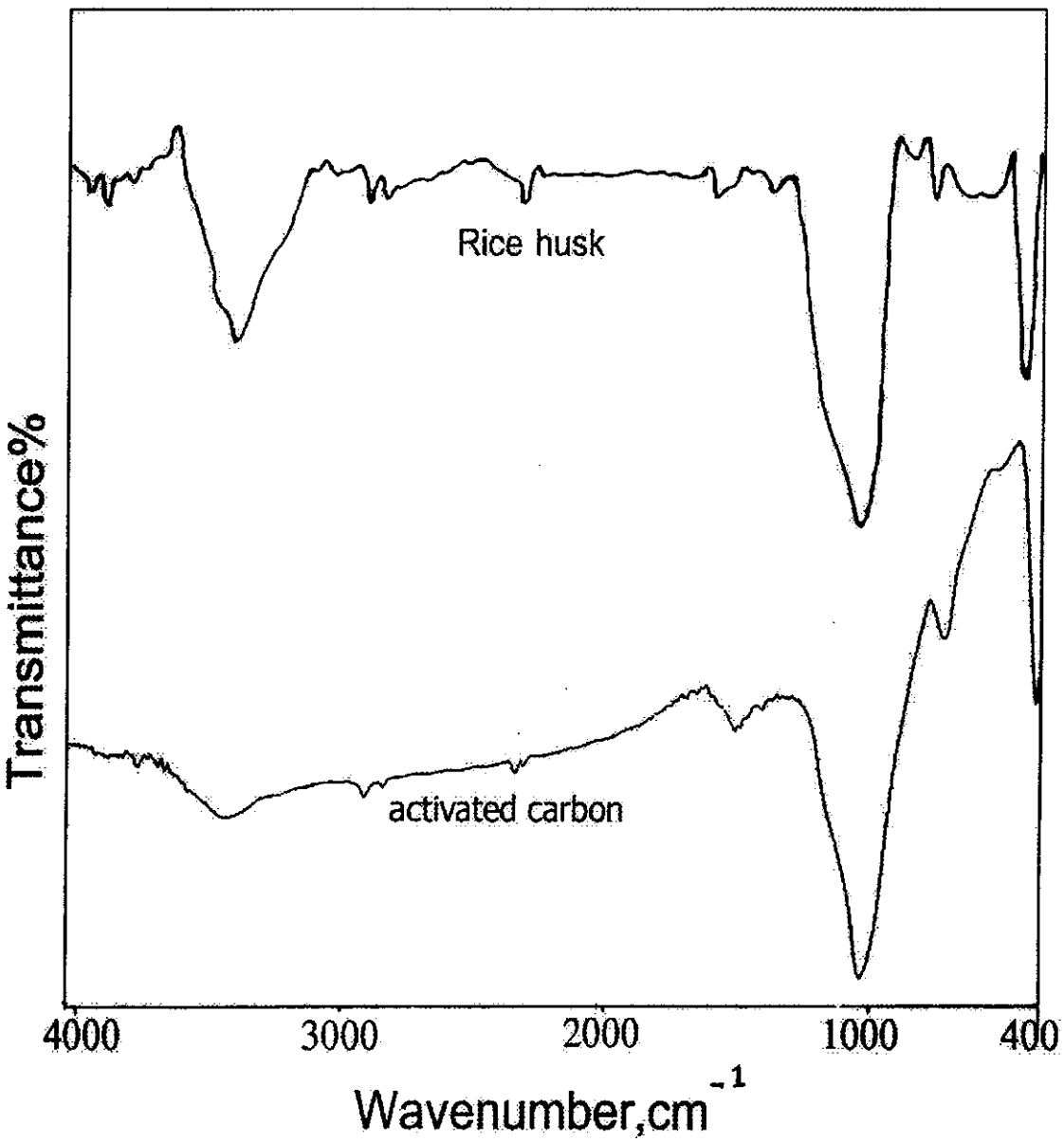

Fig.(3.2): FTIR Spectra of the original Rice husk and one – step steam activated carbon (CS-55).

3.2. SORPTION INVESTIGATIONS:

In this concern, the prepared activated carbon (CS-55) was used for removing some metal ions, namely, UO_2^{2+}, Cu^{2+} and Zn^{2+} as well as organic solutes, phenol and its derivatives. These solutes are chosen for several reasons:

Uranium :

Uranium produced as waste from many sources such as:

* Uranium and thorium mining and refining processes
* Nuclear power generators
* Industrial, medical and scientific utilization of radioactive materials

Uranium is a general cellular poison which can potentially affect any organ or tissue . Uranium and its compounds can be damaging due to its chemical toxicity [64].

Copper and Zinc:

Both copper and zinc used in many industries such as

* Making alloys
* Chemical industries as catalyst
* Electrochemical industries
* In production of pigments , paints and piping for water supply .

Both copper and zinc are essential elements for living organisms, particular to plants in small concentrations but at higher concentration, copper and zinc are harmful and toxic to various organisms. In drinking water, copper imparts a bitter tast in amounts greater than 1 mg / L but at level above 5 mg / L zinc imparts a bitter tast to drinking water[65].

Phenol :

Phenol and its derivatives (p- nitrophenol , p-chlorophenol and p – methylphenol) are used in this work because phenol and phenolic compounds are utilized in manufacturing or produced as by products in many industries such as halogenated

organic pesticides, petroleum refineries, paint, paper, plastics, textile and wood. Phenolic wastes are highly toxic for both humans and animal[10, 65, 66].

3.2.1 Batch Mode:

3.2.1.1. Adsorption of Selected Heavy Metal Ions:

The presence of heavy metals in water supplies is of increasing concern for a number of enviromental and health – related reasons [67-69]. Much interest has been exhibited lately in the use of sorption phenomenon for metals removal[70]. In this concern, the present work is directed to examine the efficiency of activated carbon prepared from locally available agro–residue (Rice Husk) in removal of some metals of environmental and nuclear interest. These are: UO_2^{2+} , Cu^{2+} and Zn^{2+}.

Factors affecting metals removal efficiency are investigated. In this concern, the equilibrium time, the sorption rate, the carbon mass, the hydrogen ion concentration and adsorption isotherms are examined for each metal in batch mode.

3.2.1.1.1. Effect of Contact Time:

Preliminary investigations on the adsorption of selected metal ions on the carbon (CS-55) indicated that the process is quite rapid and equilibium is reached after 180 min. The adsorption process comprised of two steps: a rapid initial step followed by a much slower one. The adsorption of selected metal ions on carbon (CS-55) was very fast during 120 min. of contact time when about 80 % of the equilibrium capacity was obtained, while the remaining adsorption density was only achieved after a further 60 min. These two distinct kinetic stages in metal ion adsorption were also reported[71-73]. Figs. (3.3 –3.5) show the results of a series of kinetic experiments on the adsorption of selected metal ions (UO_2^{2+}, Cu^{2+} and Zn^{2+}) using one- step steam activated carbon (CS-55).

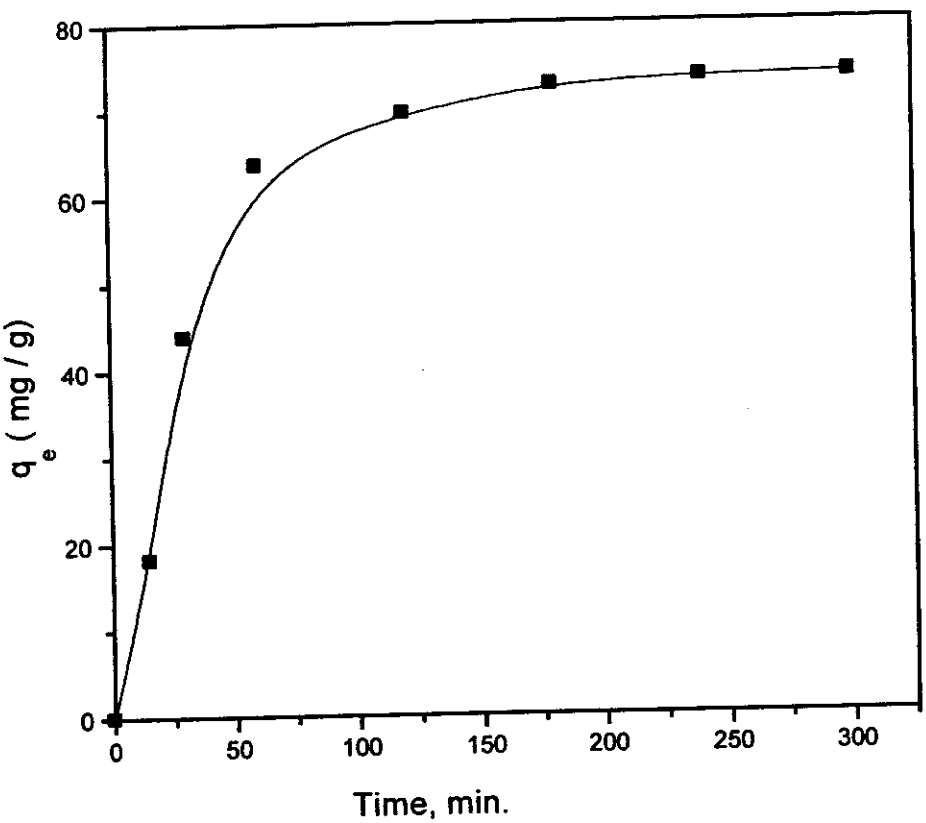

Fig. (3.3) : Equilibrium uptake of UO_2^{2+} ions by carbon (CS - 55).

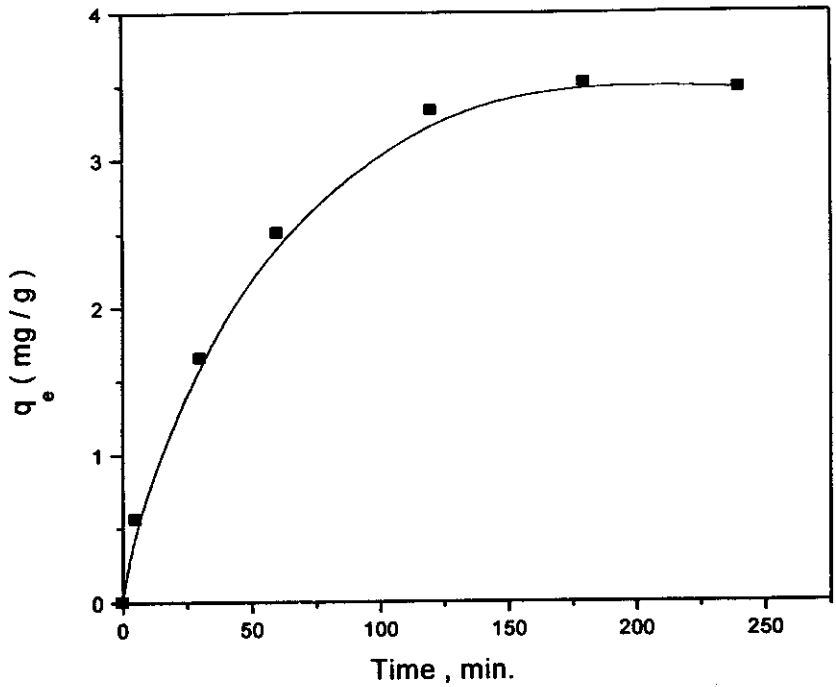

Fig. (3.4) : Equilibrium uptake of Cu^{2+} ions by carbon (CS - 55).

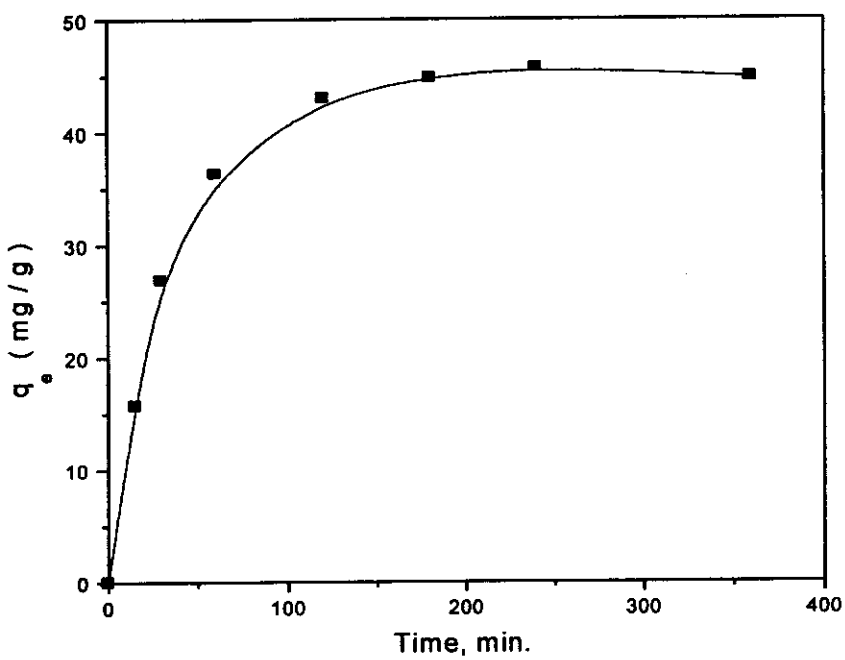

Fig. (3.5) : Equilibrium uptake of Zn^{2+} ions by carbon (CS - 55).

3.2.1.1.2. Sorption dynamics:

3.2.1.1.2 a. Rate constant Study:

The kinetics of sorption of selected metal ions under investigation on carbon (CS-55) were studied on the basis of Lagergren equation. [10, 74, 75]

$$\log(q_e - q) = \log q_e - (\frac{K_{ad}}{2.303})t \qquad \text{.....(3.1)}$$

Where q (mg . g^{-1}) is the amount of metal ions sorbed at time t , q_e (mg . g^{-1}) is the amount sorbed at equilibrium and K_{ad} is the equilibrium rate constant of sorption . The straight line plots (Figs. 3.6 – 3.8) of log ($q_e - q$) vs. t for different metal ions indicate the validity of equation (3.1) and the process follows first order rate kinetics . The K_{ad} – values of metal ions were calculated from the slopes of these plots and the results are given in Table (3.2).

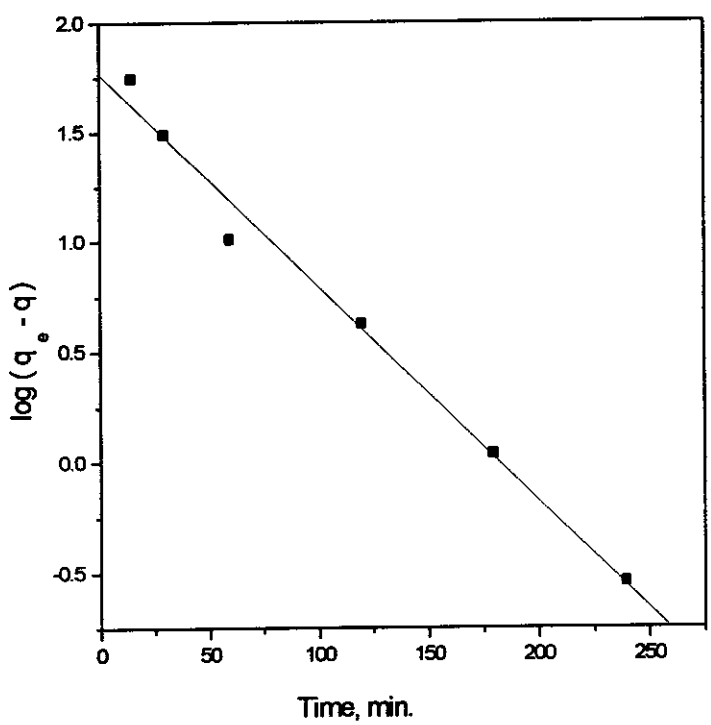

Fig. (3.6) : Lagergren plot for the adsorption of UO_2^{2+} ions on carbon (CS - 55) .