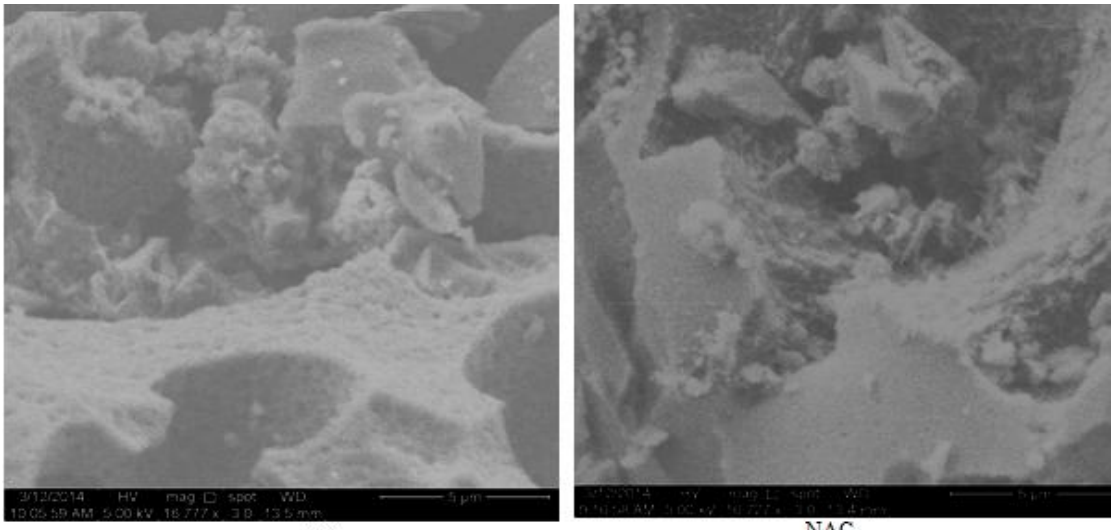

Figure 1: SEM images for the AC and NAC samples that synthesized from IDDPS

3.5 FTIR spectroscopies of AC samples

Functional groups of the AC surface were investigated using FTIR spectroscopy. Generally both AC and NAC FTIR spectra are almost similar, these spectra show three main peaks from 1380 to 1690 cm^{-1}.The broad peak that appears around 1690-1715 cm^{-1} can be assigned to the stretching vibration modes for C=O bonds that are present of the both AC and NAC surfaces. The other band thatappeared around 1430 cm^{-1}can be assigned to the stretching vibration mode of C-C bondsof the ACs surfaces[28]. The relatively broad band that appears around 1590 cm^{-1} can beassigned to vibrations modes of aromatic rings that are present on the surface[29]. In addition to that, both of AC and NAC show absorption band around 3000 cm^{-1} which confirms peak confirms the presence of the unsaturated alkynes C=C bond on the AC surface.Thebroad bands that appear around 3300- 3650 cm^{-1}can be assigned to vibration of OH groups[29]. FTIR spectra for AC and NAC samples are presentedin Figure 2.

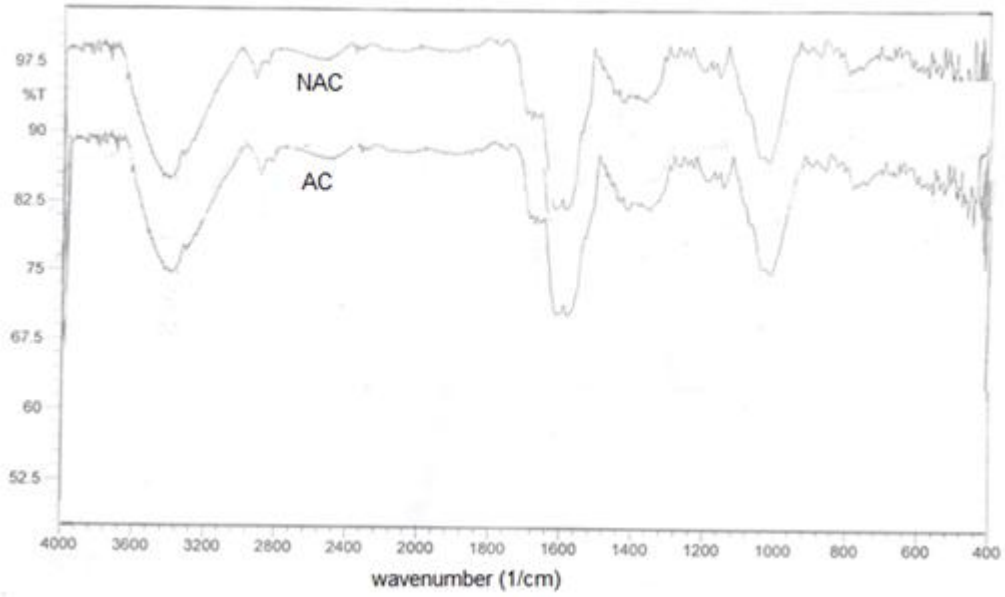

Figure 2: FTIR spectra for AC and NAC samples that synthesized from IDDPS

3.6 The point zero charges of the activated carbon (PZC)

The PZC of the synthesized activated carbon in this study were estimatedusing potentiometric method. The obtained results are shown in Table 5. From these results, the PZCs values of both AC and NAC showed in almost basic value (8.20- 8.45). This indicates that these materials are showed an alkaline pH values. The PZC values of both AC and NAC are presented in Table 4.

Table 4: The point zero charges for the synthesized AC and N AC

Sample	AC	NAC
pH of AC	8.20± 0.1	8.45±0.08

3.7Effect of AC loading and contact time on dye removal

To study the effect of duration of reaction time for the used AC and NAC samples on removal of RY145 from simulated industrial wastewaters. The obtained results for this study are presented in Figure 3. From these results it can be seen that, there is a incrementin the removal of dye upon adsorption on AC and NAC. For all experiment batches, a shaking process for a time duration of one hour at 25 ºC under normal atmospheric conditions was applied to achieve a adsorption equilibration for all doses of the used AC [30]. Generally, the obtained results showed a progress development in dye removal on AC with time for both AC and NAC. This development in dye removal with time for this case is probablydue to increase of uptake adsorption capacities of the used ACs as a function of time.

Comparing the ability of each type of AC in dye removal under the same applied conditions, it can be seen that, AC was more efficient than NAC in dye removal as it shown in Figures3 and 4. This is probably arises from difference in porous structure of AC which makes it has high humidity percentage and low ash contents in comparison with NAC. In addition to that, AC has higher uptake adsorption capacity in comparison with that for NAC. The results of removal of RY145 over both AC and NAC are summarized Figures 3 and 4.

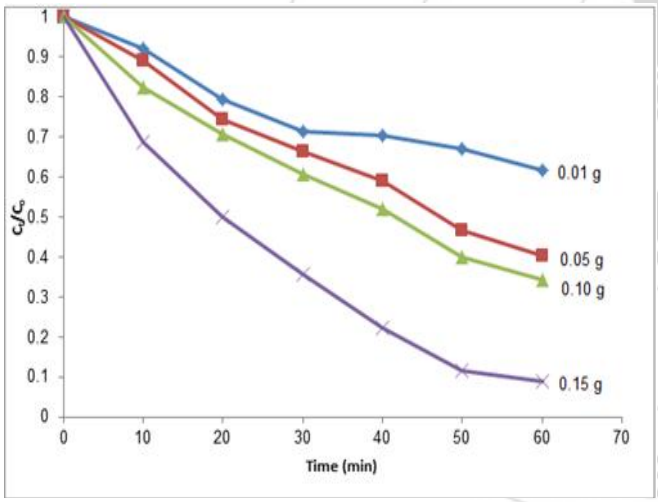

Figure 3: Effect of contact time and dosage of ACon the removal of RY145 dye from simulated wastewaters.

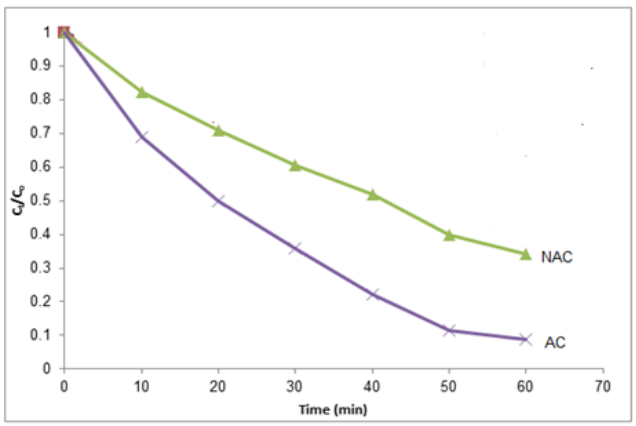

Figure 4: Comparison of activity of AC and NAC on RY145 removal under the same conditions

3.8 Effect of temperature on dye removal over AC

The effect of reaction temperature on dye removal was investigated by performing dye removal over AC at three different temperatures and the obtained results are presented in Figure 5. From these results it can be seen that there was increased in the efficiency of dye removal with increase of the temperature and the best removal was achieved at 30 C and the lowest results was achieved at 20 C.This probably arises from the effect of temperature on increasing of the kinetics energy and this leads to increase the diffusion of the adsorbed species into the surface of the used AC. This process can lead to increase the efficiency of adsorption of RY145 from the bulk into the surface.

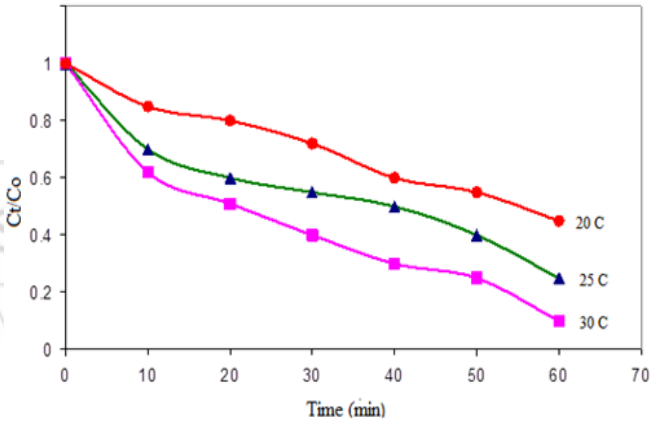

Figure 5: Effect temperature of reaction mixture on adsorption of RY145dye over the used AC

The surface area of the catalyst increases with decreasing of particle size, this can provide more sites that are contributed in the adsorption of the dye. Low efficiency in dye removal at size 100 is probably due to the aggregation of these small particles to form agglomerate in the reaction mixture. This can lead probably to reduce the activity of dye removal using this small particle size[31].

3.9 Effect of pH of reaction mixture on dye removal

pH of reaction mixture can effecton the charge of the surface and this would effect on adsorption/desorption processes on the surface. This depends on the net charge of adsorbed species on the surface. Variation of pH of reaction mixture was conducted by adding controlled amount of acid and base into the reaction mixture and the reaction was performed at three pHs values 3,7, and 9. The results of pH effect on dye removal over AC are summarized in Figure 6.

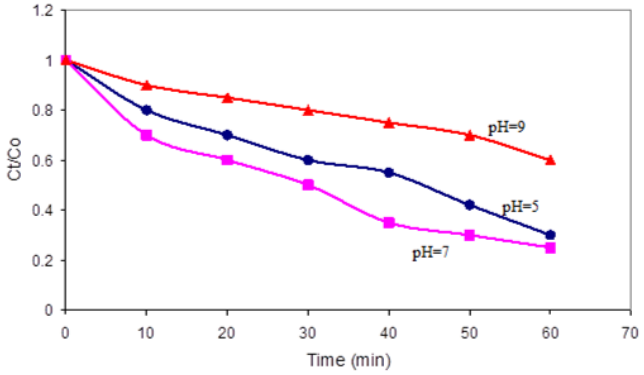

Figure 6: The effect of pH of reaction mixture on the removal of RY145 dye over AC

From these above results,it can be seen that, efficiency ofRY145 dye removal over the used AC were varied with the change in pH values of the reaction mixture and under applying the same reaction conditions. From the obtained results the best removal efficiency for this dye was achieved at neutral media at around pH=7 (around 85%) . On the other hand, the lowest efficiency was obtained at basic media around (pH=9). It is clear that neutral pH value (pH=7) showed higher removal efficiency for the RY145 dye from simulated industrial wastewaters. This observation is probablyarises from low adsorption ability of this dye on the surface at acidic and basic pH values. This probably leads to repulsion between adsorbed species and the surface which reduces the efficiency of dye removal under these conditions [32,33].

4. Conclusions

In this study activated carbon was synthesized from Iraqi deegle date palm seeds using chemical activation method. Adsorption activity of the synthesized AC was investigated by following the removal of RY145 dye from simulated industrial wastewaters. The synthesized ACshowed high uptake adsorption capacity which makes this material as a good candidate adsorbent.In addition to that,this type of AC showed low ash content with high humidity content.

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