ABSTRACT
Corrosion problems occupy a large important forasmuch the damage that it causes whether on the spirits or costs; therefore it is necessary trying to find methods to limit corrosion process. Science is a multidisciplinary area of research where nanotechnology potentially offers the opportunity to enhance the understanding of concrete behavior, to engineer its properties and to lower production and ecological cost of construction materials. Nano science and technology is a new field of emergence in materials science and engineering, which forms the basis for evolution of novel technological materials. Nano technology finds application in various fields of science and technology.
This research aims to study the effect of different concentration of HCl on the corrosion rate and flexural capacity of RC structures. Also, the effect of different accelerated corrosion periods on the corrosion rate and flexural capacity of RC structures was considered. In view of appearance Nano technology as solution to limit the corrosion for steel bars in RC structures, Nanoparticles were used with different types and concentrations to study its effect on the corrosion rate, mechanical properties of concrete and flexural capacity for RC slabs. In this research, An experimental program of three different groups were carried out, these three groups are steel bars, reinforced concrete cylinders and reinforced concrete slabs. Twenty-four steel bars treated by different treatment methods of nano-CaCO$_3$ particles were exposed to different HCl concentrations (0, 1, 2, 3, 4 and 5%). 144 RC cylinders with different nanoparticles CaCO$_3$, SiO$_2$, Al$_2$O$_3$ and MgO with different concentrations (0, 0.5, 1, 2, 3 and 5%) to each nano type were exposed to different concentrations (0, 0.5, 1, 2, 3 and 5%). Thirty-one reinforced concrete slabs treated by nano- CaCO$_3$ particles were exposed to different HCl concentrations (0, 2, and 5%) and accelerated corrosion setup periods.
The electrochemical behaviors of reinforcing steel were determined by linear polarization techniques for the three groups by using voltalab 10 PGZ100 "all- in –one" Potentiostate / Galvanostate system in order to measure corrosion rate for every group. Compressive strength of groups two and three was recorded in order to know the effect of HCl media and nano treatment on strength of concrete. Frame loading test was performed on group three to know the flexural capacity of slabs and corresponding deflection under the effect of different HCl, nanoparticles concentration.
and variable accelerated corrosion setup periods. Electrochemical results for steel bars group indicated that the increase in HCl concentration causes increase in corrosion rate. By introducing nano treatment, it was found that corrosion rate of steel bars decreased. Compressive strength and electrochemical results for group two show an improvement of mechanical properties of concrete and high ability to resist aggressive attack especially in presence of alumina dioxide and silica dioxide nanoparticles, this result reflects on the corrosion behavior of reinforcing steel in concrete containing these nanoparticles. Both alumina dioxide and silica dioxide reduce the chance of reinforcing steel to corrosion to region of passivation. Calcium carbonate gets the same behavior of alumina and silica dioxide but with less efficiency and with another mechanism. The impacts of nano- magnesium oxide particles are negative especially with high concentration. From results of electrochemical test, it was found that HCl contained in slabs increase corrosion rate, while utilization of nano treatment decreases the corrosion rate. The compressive strength and the flexural test results illustrate that concrete strength increases in the presence of HCl media or nano treatment. It was recorded reduction in ultimate load capacity with the increase in the accelerated corrosion setup period. This research illustrated the importance of nanoparticles in limiting reinforcement corrosion in concrete and increasing concrete strength.