A Review on the Green and Nano Composite Cement for Carbon Capture and Sequestration Project

Abid, K.[1], Romero Tellez, M. L.[1], Ahmed, S.[2], Teodoriu, C.[3]
[1]The University of Oklahoma, Norman, United States, [2]Barton Community College, Great Bend, KS, United States, [3]The University of Oklahoma, MPGE, Norman, United States

Global warming is one of the biggest challenges faced by the world at present, in which one of the major contributors is the release of greenhouse gases into the atmosphere especially CO_2. Therefore, many countries are moving towards a net zero goal, which dictates that the amount of greenhouse gas released should be balanced with the same number of gases removed from the atmosphere. In that respect carbon capture and sequestration (CCS) projects plays an important role in which CO_2 can be injected into the suitable subsurface geological formation. The success of the CCS project is dependent upon three parameters i.e., capacity, injectivity and confinement. In which confinement plays a vital role as proper plugged and cemented well will be able to supress CO_2 in the subsurface layers for hundreds of years. While on the other hand if the well cement is compromised then the leakage of CO_2 to the surface can happen and the purpose of CCS fails.
Hence, it has been reported in many studies that cement exposed to CCS simulated environment has the tendency to degraded because temperature and pressure of the reservoir convert the injected CO_2 gas to supercritical CO_2, which is much more reactive towards cement sheath. This paper will review the use of agricultural waste (Palm Oil Fuel Ash and Rice Husk Ash) and nano particles (Nano Silica, Nano Glass Flakes and Multiwall Carbon Nano Tube) as a replacement in the Class G cement to modify the chemical, mechanical, rheological and transfer properties of the cement and its resistance against the supercritical CO_2 environment. The study reveals that publish data on cement mixtures with the agricultural waste shows better mechanical and rheological properties then the nano particle cement, however, there performance after exposure to the supercritical CO_2 was not good due to the pozzolanic reaction that reduced the quantity of the Portlandite, while nano particle cement performed better in CCS simulated environment.