Qualitative Assessment of Prospective Project Activities involving Carbon Capture and Ocean Storage through Alkalinity Shift

SSC-Working Group

Background

The SSC-WG was requested by the Executive Board to carry out a qualitative assessment based on inputs and clarifications by project participants on CDM project activities that involve carbon capture and storage in ocean from flue gases of coastal power plants. The Executive Board specified that the assessment should cover boundary, leakage and permanence issues and the assessment provided here considers the state of development of the technology and environmental impacts in addition to these key issues.

Technology

The proposed project activity involves flue gases from a coastal power station being pumped through flowing seawater in which limestone in porous baskets is placed. The resultant reaction converts the CO_2 contained in the flue gas to bicarbonate as below:

$$CO_2+CaCO_3+H_2O = Ca(HCO_3)_2$$

Only a fraction of the flue gases pumped in this way will be neutralised and will stay in solution. This fraction is stated to vary and the PP expects this to be about 50%.

No demonstration or tests have been carried out using flue gases from coastal power plants. It was stated by the PP that laboratory level tests have been carried out but no information has been published. Therefore the technology proposed to be used for the project activity has not been tested and proven.

Impacts on Ocean

The possible environmental impacts will increase as the size of the thermal power plant and thereby the volume of the flue gas increases. The environmental effects to be considered include the effect of increased alkalinity on aquatic life. The NO_X and SOx contained in the flue gases are soluble and can form acids. The effect of these on marine life should be investigated. The pH of the discharge will be higher than the source water. Since no tests or demonstrations have been conducted using the proposed technology, an environmental impact assessment should be carried out and an environmental management plan developed during project development.

Boundary

The proposed boundary is the physical boundary consisting of the electro-mechanical equipment proposed to be used for the activity and a boundary in sea of 20 km radius from the cooling water discharge point. The 20 km boundary is proposed for the chemical reaction to be completed.

There may be difficulties in enforcing the project boundary for monitoring purposes due to the flow of the sea water and the bi-carbonate solution. There may also be issues, if the 20 km boundary crosses maritime boundaries of more than one country/party.

Leakage

The possible leakages involved in the project activity are relating to mining of calcium carbonate, transport of calcium carbonate and release of CO_2 during the use of the bi-carbonate by marine organisms.

The emissions associated with electricity consumption for pumping the flue gases through the sea water and $CaCO_3$ baskets will also need to be considered as leakage.

Since the mass of the $CaCO_3$ used would be 3.5 times the CO_2 stored. The emissions resulting from mining and transport of $CaCO_3$ should be considered. Marine organisms use calcium carbonate which frees the CO_2, which may in turn get converted to organic carbon. The leakage from biological use can be neglected.

Permanence

It should be noted that only about half of the flue gas bubbled through the sea water and calcium carbonate baskets will stay in the bicarbonate solution. Once the CO_2 is converted to bicarbonate, the calcium carbonate will precipitate and the CO_2 will be released. This release will need to be examined further to see what level of precipitation will occur during the crediting period and thereafter.

Conclusions

The technology for carbon capture and ocean storage is in its early stages of development and is yet to be tested and proven under lab or field conditions for application in conjunction with coastal power plants. In addition to proving the technical viability, there may be the possibility for environmental impacts which need to be assessed and possible effects addressed by an environmental management plan before large scale project activities should be considered.

Significant methodological concerns and challenges exist in permanence, leakage and boundary issues relating to these types of project activities. The working group feels that project activities to be considered under CDM should use technology which is proven under field conditions and that CDM should not be used for demonstrating laboratory scale-technologies. It may be noted that considerable amount of efforts by panels and working groups may be required to address the methodological issues of these unproven technologies without significant immediate potential.