DOI: 10.5937/IOC25729S

CONSTRUCTION AND TECHNOLOGICAL PROGRESS OF A COMPREHENSIVE CARBON REDUCTION SYSTEM FOR CCUS IN THE STEEL INDUSTRY

Wei Su[1a], Yi Xing[1b], Yang Zheng[1c], Rongrong Lei[1d]

[1] University of Science and Technology Beijing, No. 30 Xueyuan Road, Haidian District, Beijing
[1a] suwei@ustb.edu.cn, 0000-0002-9314-8068
[1b] xingyi@ustb.edu.cn, 0000-0001-7594-8398
[1c] yzheng@ustb.edu.cn, 0000-0002-9723-5687
[1d] leirongr@ustb.edu.cn, 0000-0002-6848-7084

Abstract

The development characteristics of carbon capture, utilization, and storage (CCUS) technologies in the steel industry, the establishment of a comprehensive carbon reduction system, and technological advancements have been explored. The characteristics of carbon emissions in the steel industry, the current status of carbon reduction technology development, and the distinctive features of CCUS technology have been elucidated. As a significant component of heavy industry, the combustion of fossil fuels such as coal during steel production leads to substantial carbon emissions. Although China has increasingly recognized the importance of CCUS in recent years, the overall progress remains in the early stages, and there is still a need for further improvement in technology and policy support. A "6C" system is proposed to create an integrated CCUS solution encompassing the entire process, detailing the technologies, strategies, and application cases across six aspects: carbon capture, utilization, storage, verification, monitoring, and assets. It discusses how optimization can help achieve the goal of reducing carbon emissions, while also providing valuable experiences and references for carbon emission control in other industrial sectors. The progress of CCUS technology in typical steel industry scenarios has been analyzed, and three carbon reduction pathways have been proposed. The traditional blast furnace CCUS route involves capturing and separating part of the blast furnace gas source to recycle CO and utilize CO2. Addressing the current challenges of high energy consumption and costs in carbon capture, a direct solid carbon route from end-of-pipe flue gas has been proposed to lower the purity of captured CO2. The hydrogen metallurgy coupled with CCUS route aims to produce green methanol through the integration of hydrogen production from renewable energy with CCUS. The implementation of these three carbon reduction pathways will promote traditional long-process decarbonization, reduce carbon source inputs, enhance the utilization of carbon resources, and achieve high value-added utilization of products. Future large-scale demonstration projects will facilitate the internal cycling of CO2 in the steel industry and its cross-industry utilization. Recommendations and outlook for advancing CCUS technology in the steel industry have also been presented.

***Keywords**: Steel industry, CCUS, Whole process, Carbon reduction system*