Due Diligence Report on OMB Gasification Process

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The OMB Gasification technology was developed in the 1990s at the Institute of Clean Coal Technology at the East China University of Science and Technology (ECUST) and was first demonstrated in 2005, with the startup of two OMB units handling 750 and 1,150 TPD of coal. Since then, the OMB gasification technology has been selected for 20 projects that are either operating, under construction or in the development phase in China, with several being operated at a full-scale of 2000-2500 TPD coal feed. According to ECUST, the OMB process is also under consideration for several projects with western chemical firms.

Larry Rath of NETL has noted that the OMB gasifier is largely based on slurry pump feed technology like GE (Single burner) or Conoco Phillips (Dual Burners) but unlike these gasifiers it has a four burner arrangement which is the key design feature of the technology and which attributes to the claims of more stable/reliable operation and ease of scale up.

Figure 1 presents an overview of the gasifier and the process. The gasifier features four jets which inject a coal-water slurry (CWS) and oxygen into the gasifier which operates at a temperature of 1300°C and pressures between 3.0 -6.5 MPa. The key feature of the design is control of the initial gasification reactions, which is done by providing thorough mixing via the four burners located at the top part of the reactor. Impinging flow from the opposed injectors forms a well mixed impact flow field which enhances mass and energy transfer and ensures that the evaporation of water and the initial gasification reactions, heating of the particles, release of volatiles and initial cracking reactions predominate instead of combustion. The residence time is only a few seconds. The secondary reaction occurs mainly in the pipe flow region where the principal reaction is the gasification of char. The result is high carbon conversion, minimization of char and a high content of CO and hydrogen in the syngas. Also, the use of four burners makes it possible to easily increase the capacity of a single unit. In addition, the impinging flames restrain CWS gasification in the center of the primary reaction zone, which avoids scouring the refractory wall and prolonging the life of the vessel refractory. In the OMB gasifier,

special pre-filmed burners are used, whose structure is different from the premixed nozzle used by the GE (Texaco) gasification technology.

The high-temperature syngas from the gasification chamber, attached with the melting slag, is cooled and washed in the multi-bed structural quenching chamber (spray and bubble beds) which has demonstrated excellent performance to reduce entrainment of water and ash by syngas leaving the quench chamber.

The syngas primary purification section utilizes a step-by-step approach consisting of a mixer, cyclone separator and a water scrubber to achieve high energy efficiency of the process to remove water drops and solids in the syngas. The content of the fine ash entrained by the syngas can be decreased to a minimum and the pressure drop is lower compared with other cleaning concepts used in gasifier technology.

The key equipment of the solid water treatment sections is an evaporative hot-water tower in which steam contacts directly with recycled grey water to enhance heat and mass exchange.

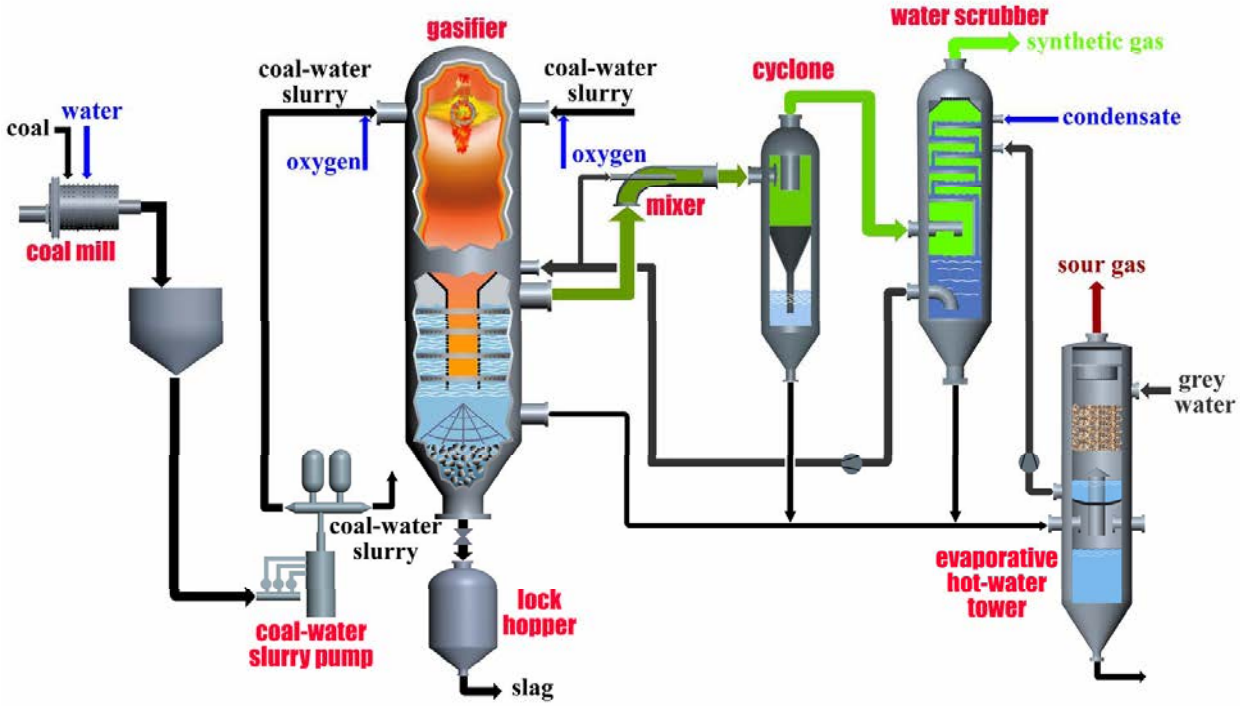
Practical operating experience indicates that the OMB technology has high carbon conversion efficiency (>98%), high CO + H_2 content in the syngas (~81-84 vol%), very low combustibles in dry slag (<2%) and the specific coal consumption and oxygen consumption is lower compared to the GE/Texaco gasifier. Because of its superior performance, the OMB technology has made great progress in commercial applications in China, as mentioned above.

Another key feature of the CWS-based OMB process is the ability to gasify lower grade feedstocks. There is an increasing trend to use low rank coals with high ash content or high ash melting point for gasification, particularly in China, where there are abundant reserves of low quality coal which are typically unsuitable or uneconomical for operation in commercial gasifiers. Traditional gasifiers don’t work as well if there’s a high ash content and require extensive drying for high moisture containing coal. However, lower quality comes with low market prices which may make OMB gasification an attractive viable solution for these types of coals as well as to the abundant supply of fines and culm wastes which has been generated by the coal industry worldwide. Most importantly, the OMB gasifier is well suited for gasifying the

entire biomass spectrum which is likewise seeing a lot of attention globally as a means to replace fossil fuels and reduce the carbon emissions footprint of fuel plants.

Because of these distinct advantages discussed above, an experimental gasifier based upon the OMB technology offers considerable value to the US coal and biomass gasification development programs. Addition of this promising new technology to the DOE development programs should be considered and utilized to test the country's many different abundant domestic energy feedstocks, including biomass, waste coals, low grade coals and co-feed blends thereof in efforts to develop new low-cost coal and coal-biomass gasification. The claimed advantages and superior performance of the OMB technology may promise a means for early deployment to contribute to achieving the country's carbon reduction and clean domestic energy goals. Thus, we recommend that the DOE approve the purchase of a pilot unit of the OMB gasifier from ECUST which is to be installed and used to test various domestic feedstocks as proposed by the University of Kentucky, CAER.

Figure 1: OMB Gasification Process



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