

K - 1 Homeostasis Society and Coal Technology

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For a sustainable society, all the processes, systems, industries, and societies should be well-organized to achieve efficient use of waste heat with lowering exergy loss and to promote material recycle with minimizing emission of wastes. Such a social system should have “homeostasis” that all the lives including animals, plants, and human beings have. In this lecture, prospect of coal conversion technology in the 21st century was discussed with considering the establishment of homeostasis society system.

In a short term until 2030s, Japan should have a responsibility to support under developing countries. It is obvious that coal will be a major energy resource in these countries in contrast that natural gas will become more predominant in the developed countries. Japan should contribute to develop new clean coal technologies suitable for local sites in the developing countries.

In the middle term, it is estimated that bitumen, coal bed methane, methane hydrate, biomass and waste polymers will be used as major energy and chemical resources, instead of petroleum. The development of new technologies for these new resources is obviously essential. R&D of these processes should start as early as possible, as it takes longer time to establish new technologies. We should recognize that clean coal technologies that have been developed and are going to be done provide the basic and common technologies for the new processes. For example, solid fuel handling, conversion (liquefaction or gasification), desulfurization, denitrogenation, purification, and its process and system control can be applied for those processes.

In a later period in 21st century, the importance of coal as a primary energy resources will not be changed or rather more significant. Especially, the demand in the developing countries will be gradually increased over the 100 years. From the viewpoint of establishing the homeostasis society, the technology using endothermic reactions to recover waste heat is essential. Steam gasification (including mild gasification) of coal is one candidate for the method. Use of catalyst and high temperature/pressure water can reduce the reaction temperature to 350 C, which implies variety of use of this reaction for the recovery of waste heat. Another important aspect for the homeostasis society is material recycle. Chemical products that can be recycled after the use will be designed in the future. Assembly of chemical blocks to produce specialty chemical products and its disassembly to recover the original chemical blocks will be a key technology in the future. A controlled decomposition method of waste polymers, or natural resources including coal or biomass to recover main chemical structures will be required in this period.

As discussed above, various technologies should be developed for a homeostasis society. “Structuring of knowledge” is essential to establish a platform of new technologies, biomass conversion, wastes conversion, bitumen conversion and the new coal conversion. Coal conversion technologies that have been developed so far and clean coal technologies contain essential knowledge for developing these new technologies. I think “structuring of knowledge”, namely summarizing the knowhow of coal technologies, and reorganizing them for the rational design of new technologies, is essential.

For establishing homeostasis society, a new research of fusing science, technology and society is important. I believe that the collaboration among Government-Industry-Academia-Social Citizen is essential to create the new society.

Figure Primary Energy Resources and Prospect of Coal Conversion Technology

