

## Chapter 5

# Special Systems of Technology

### ABSTRACT

*Special technical system (ST) is a complex arrangement of process, control, information and logistic elements, and relations that realise purposeful technologies of energy goods and resources processing, product manufacturing, and services provision. Complexity of the special system guarantees a high degree of integration in respect of melioration of the natural environment (O), using and creating values of culture and knowledge of the boundary zone (SG). Specificity of special systems results primarily from their design, technology employed, as well as functionality and intended use of the system. Use means application of a technical object according to its intended use and functional properties in order to satisfy needs of people (society). During the operation of a machine, different types of energy are transformed into mechanical useful work where relations between elements of the machine that work together occur as relevant forces (of reactions, loads). Therefore, each technological system is a special system in the context of the technical solution used, specificity of the production process or services, materials used, environmental working conditions, quality and safety requirements, systems limiting negative influence on the environment, level of demand for energy and resources, organisation, and management methods.*

### 5.1. COMPLEXITY OF THE SPECIAL SYSTEM

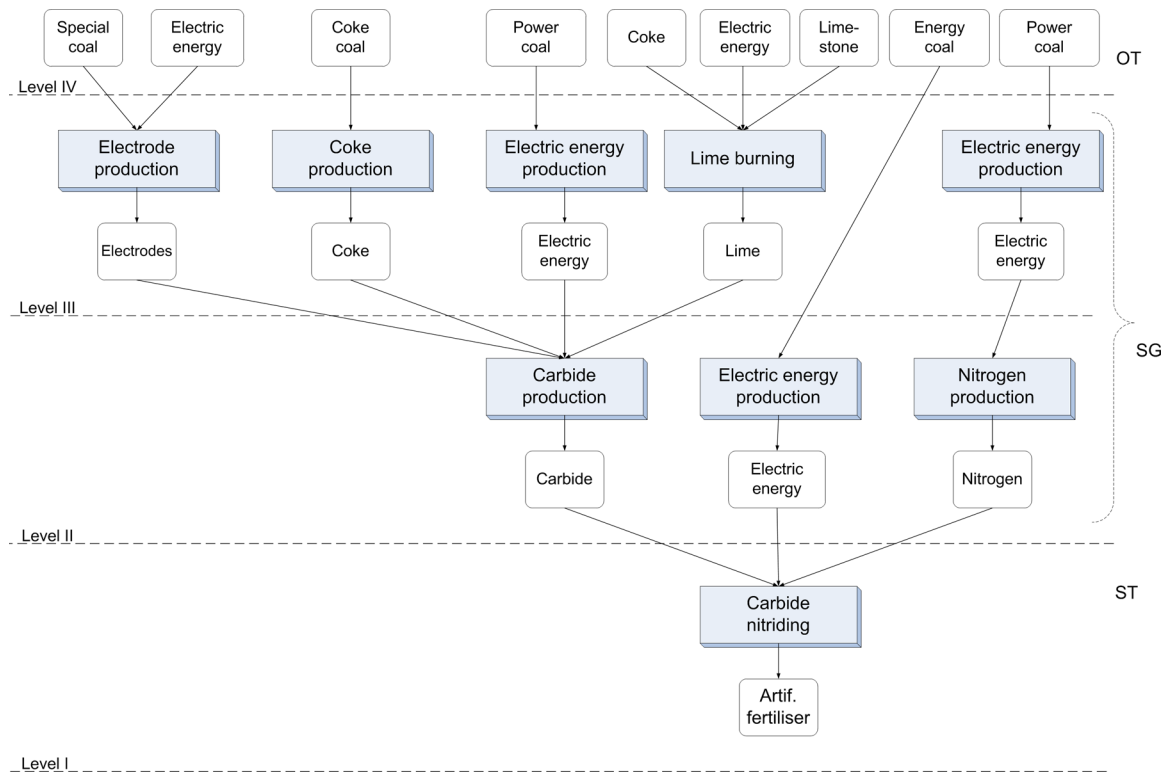
As already mentioned in chapter 1, each technical object in a technological cycle is related, through actions (changes), to the environment (surroundings); an output of the system is at the same time an entry into the surroundings, while the surroundings output is at the same time an entry (input) into the technical system (Figure 1).

The surroundings are the part of the environment located in the immediate vicinity of the technical object, which influences its operation. Regardless of its specificity, each system, at the design, operation stage, is evaluated for achieved level of energy, economic and environmental efficiency. Under certain environmental conditions of system operation, the evaluation is usually based on the comparison between the obtained values of efficiency indicators and reference values.

One of the energy efficiency indicators of a technological system is its energy demand under-

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Figure 1. Technological system for production of artificial fertiliser (Bojarski, 1984)



stood as a ratio of energy used to manufacture a unit of the end product. With very complex structures of technological systems, their energy demand is analysed at so many levels of detail that primary energy resources appear at all system inputs. Figure 1 shows a sample structure of a complex technological system, with the following elements marked: analysis levels, production sub-systems and flows of basic products. That is a typical tree-like structure. The number of semi-finished products increases with each subsequent level of the analysed structure.

That is an example of the structure for which an analytic tool is used based on determination of accumulated indicators of (energy demand) consumption of production factors in relation to the unit of final product, e.g. MJ/kg or MJ/kg.

The technological process in question must be analysed according to the division presented in Figure 1.1, in which the following are marked: the

surroundings zone OT (Figure 1 – level IV), the boundary zone SG (level III and II) and technical system zone ST (level I – Figure 1).

Special technological systems directly or indirectly fulfill human needs, not only through obtaining renewable and non-renewable goods from the natural environment, but also through material production and services in technical systems as well as products and services for men, and what is equally important – through waste (products) and meliorating services for the environment and consequently – improvement (protection) of natural resources (including energy resources).

The special system group also includes production and service systems of power and electric, heat and chemical energy etc. In each structure of a special technological system there are four types of machine, device and system designs (Ziemba, & Co-authors, 1980; Powierża, 1997; Flizikowski, 2002; Flizikowski, & Co-authors,

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