

RENEWABLE ENERGY SOURCES

8.1. Geothermal power plants (GPPs)

8.1.5. Combined cycle geothermal power plants with steam turbine in the upper cycle and volatile working substance in the lower cycle

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For wider utilization of the heat potential of geothermal steam-water mix, it is reasonable to use the combined heat scheme (fig.8.5). From the lifting hole 1 steam-water mix is fed to separator 2, from which steam flows to the back pressure steam turbine 3. After leaving the turbine, steam is supplied to condenser 4 which is a steam-generator of the volatile working substance. The formed condenser is utilized at the plant. The separated hot geothermal brine is fed to the steam superheater of the volatile working substance 5; after that it returns to stratum by the pressure hole 10. The superheated steam of the volatile working substance flows to the binary turbine inlet 6, after expansion in the turbine steam enters recuperator 7, where it is cooled and flows to air condenser 8. The condensed volatile working substance is conveyed by a feed pump to recuperator 7 for pre-heating and then to steam-generator 4. Such scheme allows to utilize heat of the separated brine for superheating the volatile working substance, resulting in increase in GPP efficiency. This scheme is the most effective at low air temperature, because at low freezing temperature of the volatile working substance (below -50°C), condensing at low temperatures can be realized. For conditions of Mutnovskoe field of steam-water mix (average annual air temperature is -5°C) electricity generation at combined GPP increases by 20% in comparison with traditional condensing cycle (it. 8.1.2). The OJSC

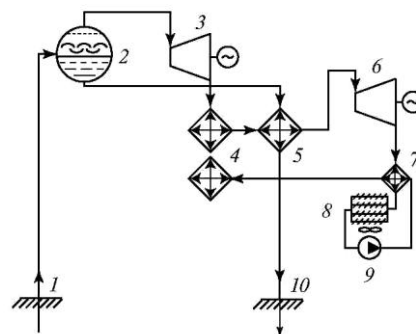


Fig. 8.5. A flow diagram of combined cycle GPP:
 1 — lifting hole; 2 — separator; 3 — steam turbine; 4 — condenser;
 5 — steam superheater; 6 — binary turbine; 7 — recuperator;
 8 — air condenser; 9 — feed pump; 10 — pressure hole.

“Nauka” and the OJSC “ENIN of G.M. Krzhizhanovskiy” received the correspondent joint patent.

Equipment of combined cycle GPP is produced by Israel firm “Ormat”, it is installed at a number of geothermal plants in Philippines and Indonesia. In Russia construction of the fourth power unit at Verkhne-Mutnovskaya GPP with total capacity of 6 MW is planned using this scheme.