BRINE STORAGES AS RENEWABLE POWER'S SOURCES.

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Solar energy accumulation and transformation by using of the solar ponds is state-of-the-art technology for power production [1-3]. The power installation operates on electrical energy production. The brine pond energy is used for hot water supply, greenhouses, habitation heating, for agricultural manufactures, for fresh water deriving.

The solar pond is a hydro- and thermoinsulated reservoir with depth 2-3m, filled with the water solution of NaCl, KCl or $MgCl_2$ salt. A salt concentration gradient is created perpendicular to the pool surface, which suppresses the layers natural pond's convection of the heated brine from bottom to surface and provides the heat accumulation at near bottom of the pond.

The power indexes of a pond are dependent on number of factors, of which the most important are: solar radiation energy, the heat exchange condition with the underlying soil and the pond construction. The heat accumulation ability of a large mass of brine results in a stable pond temperature independent of daily and even weekly level fluctuations of solar radiation and air temperature.

Hydrocarbon storage cavities in rock salt, which can contain great quantities, are used for the storing brine.

The ground brine storage is an open, isolated surface pool. It can be deep-seated (in the form of ground excavation), semideep-seated (in the form of semiexcavation- semiembankment) and surface located, using dams.

The brine storages, consisting of the hydrocarbon underground storages in rock salt, are constructed in various climatic zones in Ukraine, Belarus, Siberia, Bashkortostan, Tadjikistan and other regions.

There are problems associated with connecting reservoirs in series both for normal brine storage as well as solar ponds. For brine storages it is difficult to maintain constant pond volumes and uniform brine concentrations within each pool. For solar ponds the problem is to maintain the necessary concentration gradient. The brine is exposed to atmospheric and another external actions, which cause concentration inhomogenities both in the horizontal and vertical direction.

The water evaporation from surface, salt sedimentation on bottom, dilution by atmospheric precipitation, cooling by heat exchange with surrounding soils take place.

The research of temperature conditions of brine storages have shown a high heat accumulation ability of brine large mass.

The brine temperature at near bottom layer of brine storage, constructed in Central Asia, have been exceeded 80°C during 5-6 months. The problems of providing a reliable and durable hollow's waterproofing, that would eliminate a possibility of

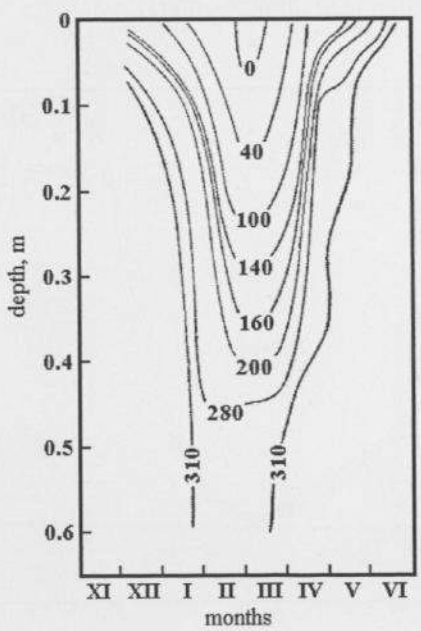

Fig.1. The distribution of brine concentration on depth of the test storage (concentration in grams of salt per liter)

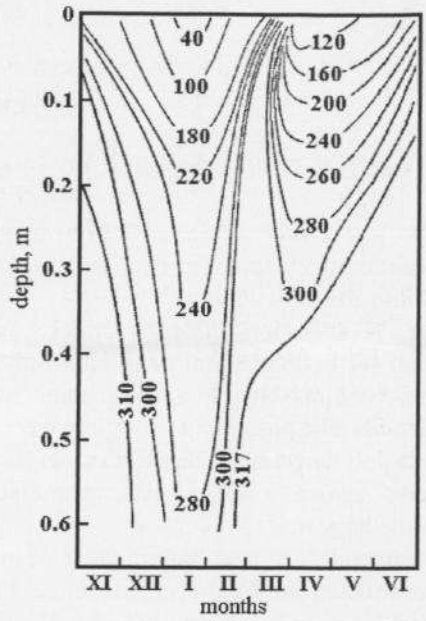

Fig.2. The distribution of brine concentration on depth of the test storage during other observation (concentration in grams salt / liter)

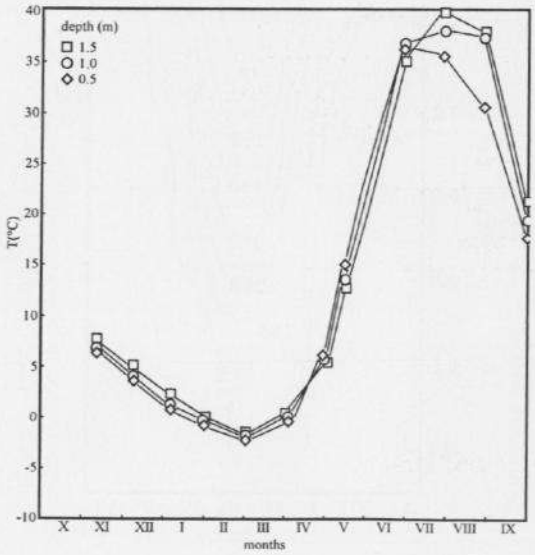

Fig.3. Change of the month-average temperature during observations (test storage near Valday town)

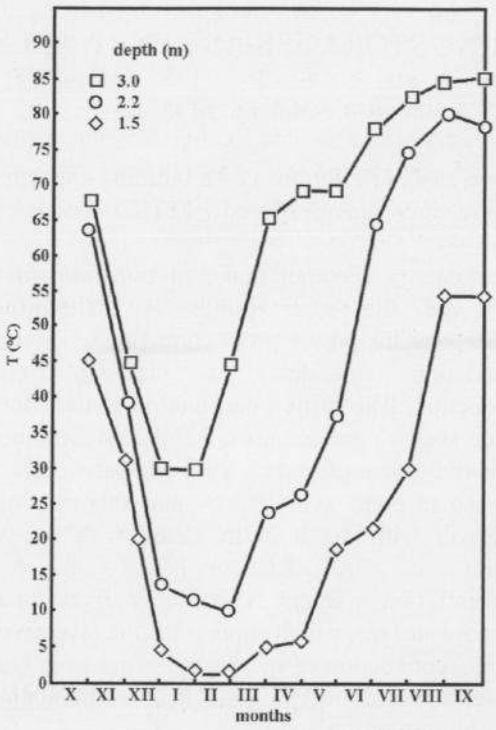

Fig.4. Change of the month-average temperature during observations (test storage in Tadjikistan)

brine filtration in surrounding soil has arisen for storage's under construction, both ground brine storages and solar ponds.

All soils are permeable for water and even more permeable for brine. The linear filtration velocity of water through different soils varies from $1.4 \cdot 10^{-4}$ m/day up to 0.2-0.5 m/day. For prevention of brine leakage, caused by penetration of salt in soils and water-bearing horizons, the bottom and lateral pool areas are covered with a screen.

The construction of waterproofing coating, able to withstand concentrated brine and solar radiation action (4) in various climatical and geological conditions have been developed by «Podzemgazprom».

The developed screen is a semivulcanized mastic, strengthened the production process, selfvulcanized, which forms a seamless hermetically closed casing. The life expectancy of this casing is 18 to 20 years.

The above-ground brine storages are analogs to solar pounds as shown by the analysis of obtained results.

The experience of brine storage projection, construction and maintenance makes it possible to estimate the possibility of it's application for thermal and electric energy production.

The scheme of a electric energy production facility using brine storage is shown on fig.5. The power plant includes a pond-accumulator, pumps, heat exchangers and steam turbine.

The scheme of a thermal energy production by using brine storage is shown in fig.6.

REFERENCES

1. D. Subhakar, Murthy Srinivasan, Saturated solar ponds. I. Simulation procedure, Solar Energy, 50 (1993) 275-282.
2. H.Z. Tabor, B. Dordon, The Beith ha'Arava 5 MW (e) solar pond power plant (SPPP) - progress report, Solar Energy, 45 (1990) 247-253.
3. O.S. Popel, N.M. Sonina, L.A. Yaskin, I.A. Zenkova, Perspectives of building of a trial solar pond in Crimea, Power construction, No. 2 (1992) 9-14 (in Russia).
4. N.M. Sonina, Yu.S. Vasyuta, Application of modified films as screens, Plastic masses, No. 5 (1981).

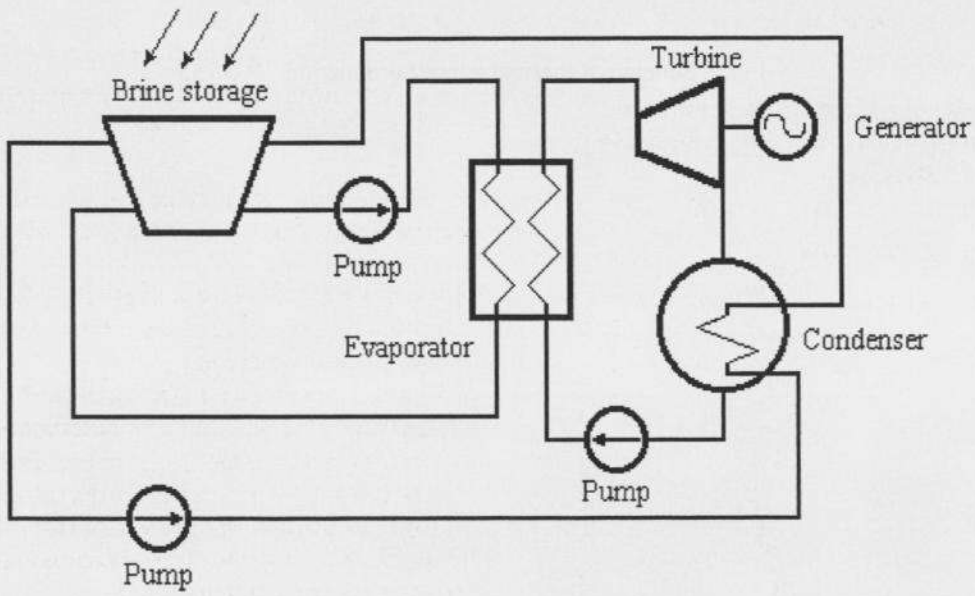

Fig.5. Scheme of electric energy production.