

Combined solar hot water supply and heating installation for autonomous units

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Combined solar hot water supply and heating installation for autonomous units using solar power has been developed.

The installation is based on solar collector modules with heat reception surface of 3.0 sq. m. Several types of collectors and respective production technologies were developed. Novelty is approved by patents and invention certificate.

- Solar water heater No. 1814003 / Ilyin A.K., Kovalev O.P., Volkov A.V., 1993.
- Solar liquid heater No. 237107 / Ilyin A.K., Kovalev O.P., Volkov A.V., 1995.
- Solar water heating installation No. 2086864 / Ilyin A.K., Kovalev O.P., Volkov A.V., 1997.

The collectors were subject to continuous tests under real conditions in industrial solar water heating installations during several years and the results proved stability of operation parameters. Industrial solar water heating and hot water supply installations developed in the laboratory have been operated in Primorye since 1991. The city of Partizansk: collectors area – 18 sq.m., accumulation tank volume – 1.8 cub.m. The city of Vladivostok: collectors area – 10.4 sq.m., accumulation tank volume – 1.0 cub.m. The village of Novopokrovka: collectors area – 18 sq.m., accumulation tank volume – 1.5 cub.m. All the installations have natural circulation. Certain experience has been gained in construction and operation of solar water heating installations of different capacity for three seasons (spring – summer – autumn) and all-the-year operation mode with regard to environmental and consumers' conditions. In 2000-2001 combined solar water heating installation with forced circulation was run into operation with solar collector area of 30 sq.m and accumulation tank volume of 1.5 cub.m. Electric boiler is used as a duplicate. Functional parameters of the installation, including heat power, are listed per 1 sq.m of solar collector.

Maximum specific heat power, kW/sq.m	up to 0.7
Heated water temperature, °C	up to 70
Specific heat water production, t/(year sq.m)	up to 15
Average heat energy production, kW-h/(year sq.m)	up to 800

Solar collectors for water heating installations were maintained by methods providing their effective operation both in natural and forced water circulation schemes (or non-freezing liquid schemes). Water heating in accumulation tanks in the schemes is carried out in one- or two-loop scheme with intermediate heat exchanger. Solar water heating installations can be widely used in the following fields:

- *In power supply systems* – preliminary additional water heating in boiler rooms;
- *In production technologies* – in hot water heating up to 80°C, in bathroom heating systems etc., in technological production, drying systems, in biotechnologies.
- *In heat supplying systems* – production and dwelling rooms, household economies, estate heating and other consumers heating;
- *In hot water supply* – hot water supply in production and household consumers, showers, farms and other agricultural units.

Implementation of combined solar installations was evaluated for Primorye only, where the average number of sunny days is 310 and sun shining duration 2000 hours. 25% of the population in not provided with central heating. 140 000 private houses are inhabited, 150 000 summer houses and 2500 farms are operated. More than 500 thousand tons of coal is spent for heating. More than 110 boiler houses are operated. Large number of productions both in urban and rural areas are not provided with heat for the most part of the year. These units can be equipped with solar installations. To provide individual family with hot water a 4-6 sq.m collector and 300 l volume accumulation tank is enough; a 2 sq.m collector is enough for summer house; and a 15-30 sq.m collector and 2 cub.m volume accumulation tank is enough for farm (depending on the field and volume of production). Thus, total demand for solar collectors in Primorye can be estimated as 1 mln sq.m. In this case 71000 t of organic fuel can be saved and environment pollution decreased considerably. Living conditions of population can be improved and heating and hot water supply expenditures can be reduced