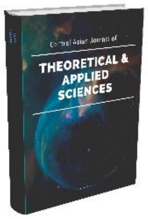

CENTRAL ASIAN JOURNAL OF THEORETICAL AND APPLIED SCIENCES

Volume: 03 Issue: 07 | Jul 2022 ISSN: 2660-5317
https://cajotas.centralasianstudies.org

On the Issue of Increasing the Efficiency of Flat Solar Collectors in Heat Supply Systems by Optimizing their Operating Parameters

Исмоилов Дилшоджон Мухторович
Zarkent Technical Service at Ferghana Polytechnic Institute, Group 6-20

Received 24th May 2022, Accepted 13th Jun 2022, Online 2nd Jul 2022

Annotation: *The article discusses issues of increasing the efficiency of solar hot water with flat solar collectors by optimizing their circuit design and mode parameters.*

Keywords: *solar collectors, solar water heating system, specific expense, heating capacity, efficiency.*

Solar heat supply systems (SST) are one of the areas in which large-scale practical use of solar energy has actually been achieved. From 2000 to 2021, the total area of installed solar collectors (SC) as part of various CCTS increased by 7.6 times and reached 875 million worldwide. m2 [1].

However, recently the growth rate of implementation has been decreasing [2], and the production of IC in China, Australia and the Middle East has been falling for the fourth year in a row. Currently, due to a sharp drop in the cost of photovoltaic modules [3], SST began to be replaced by photovoltaic installations (PV), which have certain advantages [4] compared to thermal installations: the absence of a coolant in the generating circuit, pipeline network, intermediate heat exchangers, circulation pumps, the need for measures to protect the circuit from freezing in winter and overheating in summer, convenience and ease of installation, increasing the efficiency of photovoltaic modules while reducing ambient air temperature, independence of the efficiency of water heating by an electric heater from the water temperature, etc. [3, 4]. The European IC market has been stagnating for a number of years: the volume of commissioning of collectors has been falling since 2009. From this moment on, the main task of European solar engineering science is to find ways to reduce the cost of IC and systems in general [2]. Of particular relevance in the conditions of stagnation of the market of modern ICS, having parameters close to their limit values, and the displacement of traditional solar water heating installations by photovoltaic installations, the issues of identifying the main reserves for increasing the efficiency of the use of solar thermal energy in the CST acquire. From this point of view, when designing pumping stations, an important point is to determine the optimal specific flow rate of the coolant through the SC [5]. The flow rate of the coolant through the IC is one of the main operating parameters affecting its efficiency and operational readiness of the solar hot water supply system. It is known [6] that until 1980, in pumping systems of solar hot water supply, the coolant flow rate was selected at the level of 0.015 kg/(m2 •s) or 54 kg/(m2• h). Then it was justified by the need to ensure a high value of the coefficient of heat removal FR from the SC [6]. In recent years, installations with significantly lower specific consumption have been used, providing better temperature stratification of water in the accumulator tank and the high operational readiness of the system, which, 1 to 1.5 hours after the start of the circulation of the coolant in the solar circuit, allows hot water to be

Volume: 03 Issue: 07 | Jul 2022, ISSN: 2660-5317

supplied to the consumer at the required temperature. For example, in Sweden typical unit costs range from 0.002 to 0.006 kg/(m2•s) or from 7.2 to 21.6 kg/(m2•h) [6]. The practice of designing the CST of the German company Viessmann assumes three main modes of coolant circulation through the IC [7]: a mode with a flow rate of up to 30 l/(m2• hour) (low flow); a mode with a flow rate of more than 30 l/(m2• hour) (hihg flow) and a mode with adjustable coolant flow. The optimal value for solar systems with flat collectors is considered to be 25 l/ (m2 • hour) at full pump power. With the development of solar technology, the optimal value of the coolant flow has changed, so, for example, 10 years ago, the optimal value for flat collectors was 40 l/(m2• hour) [7]. It is interesting to note that over the course of almost 40 years of global experience in designing and implementing CST with flat ICS, the value of the optimal specific coolant flow through the IC was periodically adjusted and decreased from 54 kg/(m2•hour) to 25 l/(m2•hour), i.e. more than twice, and in Sweden – 2.5-7.5 times. This is happening against the background of the fact that the parameters of the thermal engineering perfection of the SC are constantly improving and are currently close to their limit values [2]. It would seem that the value of the optimal specific flow rate through the IC should also grow along with the increase in its thermal engineering perfection to ensure greater heat dissipation. However, in practice, the opposite phenomenon is observed. This indicates that there is still no sufficient scientific justification for determining the value of the optimal specific flow of coolant through the IC for various circuit solutions of the CST (single-circuit, double-circuit, without a duplicate heat source, with a duplicate heat source, etc.), taking into account the climatic conditions of the construction area. Serious studies of the effect of coolant flow on the efficiency of the solar collector could not be found in the literature. Therefore, the design of the SST is carried out mainly by the traditional approach used in conventional heat supply systems, when thermal and hydraulic processes occurring in the system are considered separately in stationary mode for simplification. This does not take into account the thermohydraulic dynamic effects that occur in the CST and its elements with unsteadily incoming solar energy, which, when certain conditions are created, can be accompanied by synergistic effects of self-organization and self-regulation.

Literature:

1. Weiss W., Spörk - Dür M., Mautnier F. Solar Heat Worldwide. Global Market Development and Trends in 2017. Detailed Market Figures 2016. 2018 edition. Электронный ресурс: http://www.iea-shc.org/data/sites/1/publications/Solar-Heat-Worldwide-2018.pdf.
2. Фрид С.Е. Современные солнечные коллекторы: типичные параметры и тенденции их изменения/ С.Е. Фрид, Н.В. Лисицкая// Гелиотехника. – 2018. – №2. – С.27-37.
3. Фрид С.Е. Использование фотобатарей для горячего водоснабжения – опыт и перспективы/ С.Е. Фрид, А.Б. Тарасенко // Международный научный журнал «Альтернативная энергетика и экология» (ISJAEE). – 2018. – №16-18. – С.23-38.
4. Morris, G. Heating water, not as simple as it used to be / G. Morris // Solar Progress. – 2014. – No.2. – P. 30–32.
5. Рашидов Ю.К. Оценка эффективности систем солнечного горячего водоснабжения с однократным нагревом воды в плоских солнечных коллекторах/ Ю.К. Рашидов //Экологическая, промышленная и энергетическая безопасность–2018.–Севастополь: СевГУ, 2018. –С.993 – 997.
6. Даффи Дж. Основы солнечной теплоэнергетики. Пер. с англ.: Учебно-справочное руководство/ Дж. Даффи, У. Бекман. – Долгопрудный: Издательский дом «Интеллект», 2013. – 888 с.
7. Расход теплоносителя в солнечном коллекторе [Электронный ресурс].– Режим доступа: http://solarsoul.net/rasxod-teplonositelya-v-solnechnom-kollektore/. – (дата обращения: 04.01.2019).

8. Madraximov, M., Yunusaliev, E., Abdulhayev, Z., & Akramov, A. (2021). *Suyuqlik va gaz mexanikasi fanidan masalalar to'plami*. GlobeEdit.
9. Рашидов, Ю. К., Исмоилов, М. М., Рашидов, К. Ю., & Файзиев, З. Ф. (2019). Повышение равномерности распределения потока жидкости по подъемным трубам лучепоглощающей теплообменной панели солнечного водонагревательного коллектора листотрубного типа в условиях принудительной циркуляции при действии объёмных сил. In *Экологическая, промышленная и энергетическая безопасность-2019* (pp. 1377-1382).
10. АБДУЛҲАЕВ, З., & МАДРАХИМОВ, М. (2020). Гидротурбиналар ва Насосларда Кавитация Ҳодисаси, Оқибатлари ва Уларни Бартараф Этиш Усуллари. *Ўзбекгидроэнергетика" илмий-техник журнали*, *4*(8), 19-20.
11. Рашидов, Ю. К., Орзиматов, Ж. Т., & Исмоилов, М. М. (2019). Воздушные солнечные коллекторы: перспективы применения в условиях Узбекистана. In *Экологическая, промышленная и энергетическая безопасность-2019* (pp. 1388-1390).
12. Abdulkhaev, Z. E., Abdurazaqov, A. M., & Sattorov, A. M. (2021). Calculation of the Transition Processes in the Pressurized Water Pipes at the Start of the Pump Unit. *JournalNX*, *7*(05), 285-291.
13. Рашидов, Ю. К., Исмоилов, М. М., Орзиматов, Ж. Т., Рашидов, К. Ю., & Каршиев, Ш. Ш. (2019). Повышение эффективности плоских солнечных коллекторов в системах теплоснабжения путём оптимизации их режимных параметров. In *Экологическая, промышленная и энергетическая безопасность-2019* (pp. 1366-1371).
14. Arifjanov, A., Otaxonov, M., & Abdulkhaev, Z. (2021). Model of groundwater level control using horizontal drainage. *Irrigation and Melioration*, *2021*(4), 21-26.
15. Абдулхаев, З. Э., Мадрахимов, М. М., & Иброхимов, А. Р. (2021). Сув узатиш тармокларида хосил буладиган гидравлик зарб ходисасини математик моделлаштиришни тадкик этиш. *Узбекгидроэнергетика" илмий-техник журнали*, *2*(10), 33-35.
16. Рашидов, Ю. К., Исмоилов, М. М., Рашидов, К. Ю., & Файзиев, З. Ф. (2019). Определение оптимального количества расчётных слоев многослойного водяного стратификационного аккумулятора теплоты при расчете саморегулирующегося активного элемента. In *Экологическая, промышленная и энергетическая безопасность-2019* (pp. 1372-1376).
17. Абдулхаев, З. Э., Мадрахимов, М. М., & Иброхимов, А. Р. (2019). Энергия тежамкор сув кутариш курилмасининг гидравлик хисоби. *Фаргона Политехника Институти Илмий-Техника Журнали*, *25*(5), 81-89.
18. Rashidov, Y. K., & Ramankulov, S. A. (2021). Improving the Efficiency of Flat Solar Collectors in Heat Supply Systems. *CENTRAL ASIAN JOURNAL OF THEORETICAL & APPLIED SCIENCES*, *2*(12), 152-159.

