

UDC; 621.47:620.9.004.18

Oleksiienko Myhailo¹, Liush Yuliia²

¹ student of group E-513 NU “Zaporizhzhya Polytechnic”

² PhD (Tech.), assistant professor NU “Zaporizhzhia Polytechnic”

INNOVATIVE IDEAS IN THE USE OF SOLAR COLLECTORS

Modern technologies in alternative energy are developing rapidly, and one of the key elements of this process is thermal collectors. They efficiently store solar energy for heating water, warming buildings, and other needs. Thanks to innovative materials, automated control systems, and integration with other energy solutions, their efficiency and environmental benefits have significantly increased. One of the most important areas of improvement is reducing heat loss and optimizing design. The use of reflective concentrators and vacuum tubes increases efficiency, allowing effective use of even diffused sunlight.

Table 1 – Of changes in solar collector efficiency with the advent of new technologies

Year	Collector Type	Technology	Efficiency (%)
2000	Flat Plate Collector	No Selective Coating	~40%
2005	Flat Plate Collector	Selective Coating	~55%
2010	Vacuum Tube Collector	Basic Model	~60%
2015	Vacuum with Heat Pipe	Enhanced Insulation	~70%
2020	Vacuum + CPC Reflectors	Concentrated Energy	~75%
2023	Hybrid PVT Collector	Combined (Heat + Electricity)	~80%
2025	Nanocoating, Tracking	Intelligent Control Systems	~85%

Modern collectors are made with nanomaterials that provide better insulation and high resistance to external conditions. Selective coatings help absorb

maximum energy while reducing heat loss. The use of polymer components lowers weight and production costs without reducing efficiency. Another important aspect is combining thermal collectors with modern energy technologies such as heat pumps, energy storage systems, and smart grids. This allows heat to be stored in special tanks and used during peak demand. Integration with hybrid systems that include solar panels helps make the most of renewable energy sources.

The introduction of Internet of Things (IoT) technologies and artificial intelligence (AI) significantly improves the performance of thermal collectors. Sensors that measure temperature, humidity, and sunlight levels allow systems to automatically adjust, reducing energy waste and increasing productivity. Remote monitoring and control through mobile applications enable users to track energy consumption in real time. Innovations also contribute to environmental safety. The use of eco-friendly materials and technologies helps reduce CO₂ emissions. At the same time, recycling programs for old collectors help reduce waste and reuse valuable materials.

The modernization of thermal collectors focuses on improving efficiency, minimizing energy loss, integrating with other technologies, and automating operations.

The use of advanced materials, digital solutions, and environmentally friendly approaches makes them an important part of renewable energy development.

Thanks to these advancements, they continue to improve, supporting sustainable growth and reducing dependence on traditional energy sources.

REFERENCES

1. Мельник В. В. (2020). Альтернативні джерела енергії: Технології та перспективи розвитку. Київ: Наукова думка.
2. Гринчук В. М. (2019). Теплоколектори та їх роль у розвитку альтернативної енергетики. Журнал відновлюваної енергії, 5, 45-52.
3. Петренко О. М. (2018). Сучасні тенденції використання сонячної енергії в Україні. Харків: ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ ім.
4. Литвин І. В. (2017). Технології збору та використання сонячної енергії. Енергетика та енергозбереження, 4(3), 13-18.
5. International Energy Agency. 'Solar heating and cooling.' Available at: www.iea.org
6. Renewable Energy World. 'Advances in Solar Thermal Technologies.' Available at: www.renewableenergyworld.com
7. US Department of Energy. 'The Future of Solar Energy.' Available at: www.energy.gov