NANOMATERIAL VA SUN’IY INTELLEKT INTEGRATSIYASI ASOSIDA QUYOSH PANELLARINING SAMARADORLIGINI OSHIRISH

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Anotatsiya: *Ushbu ishda quyosh panellarining samaradorligini oshirishda nanofluid sovutish tizimlari va sun’iy intellekt (AI) texnologiyalarini integratsiyalashning nazariy asoslari o‘rganiladi. Adabiyotlar tahlili shuni ko‘rsatadiki, nanofluidlar yuqori issiqlik o‘tkazuvchanlik xususiyati tufayli panellarning ishchi haroratini kamaytiradi, sun’iy intellekt esa sovutish jarayonini real vaqt rejimida optimallashtirish imkonini beradi. Nanofluid va AI integratsiyasi asosida ishlab chiqilgan gibrid tizimlar energiya samaradorligini oshirish, issiqlik yo‘qotilishini kamaytirish va panellarni barqaror ishlashini ta’minlashda istiqbolli yo‘nalish hisoblanadi.*

Kalit so‘zlar: *quyosh panellari, nanofluid, sun’iy intellekt, issiqlik almashinuvi, optimallashtirish, energiya samaradorligi.*

Annotation; *This study explores the theoretical foundations of integrating nanofluid-based cooling systems and artificial intelligence (AI) technologies to improve the efficiency of solar panels. A review of the literature shows that nanofluids, due to their high thermal conductivity, effectively reduce the operating temperature of photovoltaic modules, while AI enables real-time optimization of cooling processes. Hybrid systems based on nanofluid–AI integration demonstrate potential for enhancing energy efficiency, minimizing thermal losses, and ensuring stable panel performance in hot climatic conditions.*

Keywords: *solar panels, nanofluid, artificial intelligence, heat transfer, optimization, energy efficiency.*

Аннотация: *В данной работе изучаются теоретические основы интеграции систем охлаждения на основе наножидкостей и технологий искусственного интеллекта (AI) для повышения эффективности солнечных панелей. Анализ литературы показывает, что наножидкости благодаря высокой теплопроводности снижают рабочую температуру фотоэлектрических модулей, а искусственный интеллект позволяет оптимизировать процессы охлаждения в реальном времени. Гибридные системы на основе интеграции наножидкостей и AI демонстрируют*

перспективность в повышении энергоэффективности и стабильности работы панелей.

Ключевые слова: *солнечные панели, наножидкости, искусственный интеллект, теплообмен, оптимизация, энергоэффективность.*

So‘nggi yillarda quyosh energiyasi sohasida samaradorlikni oshirish bo‘yicha olib borilayotgan tadqiqotlar asosan issiqlik boshqaruvi va aqlli nazorat tizimlariga qaratilgan. Quyosh panellari ishchi haroratining oshishi ularning elektr chiqishini 0,4–0,5 % ga kamaytiradi [1]. Shu sababli, panellarni sovutish va ularni optimal holatda ushlab turish qayta tiklanuvchi energiya sohasining dolzarb masalalaridan biridir.

Nanofluid asosidagi sovutish tizimlari issiqlik almashinuvini kuchaytirish orqali samaradorlikni oshiradi. Tadqiqotlarda Al_2O_3, CuO, TiO_2 kabi nanomateriallar asosidagi nanofluidlar yordamida panel haroratini 10–15 °C ga kamaytirish va elektr samaradorligini 10–12 % ga oshirish mumkinligi aniqlangan [2]. Shu bilan birga, bunday tizimlar oddiy suyuqliklarga nisbatan yuqori issiqlik o‘tkazuvchanlikka ega bo‘lib, panellarning uzoq muddatli barqaror ishlashini ta’minlaydi.Sun’iy intellekt texnologiyalari esa bu tizimlarning boshqaruv qismida muhim rol o‘ynaydi. Mashinaviy o‘rganish va neyron tarmoqlar yordamida quyosh panellaridan olinadigan real vaqt ma’lumotlari (issiqlik, nurlanish, havo harorati, quvvat chiqishi) tahlil qilinadi va shu asosda sovutish suyuqligining oqim tezligi yoki ish rejimi avtomatik tarzda optimallashtiriladi [3].

Quyosh panellarining samaradorligini oshirishda nanofluid va sun’iy intellekt texnologiyalarini integratsiyalash eng istiqbolli yo‘nalishlardan biridir. Nanofluidlar yuqori issiqlik o‘tkazuvchanlik xususiyati orqali panellarning ishchi haroratini pasaytiradi, shu bilan birga AI texnologiyalari bu jarayonni real vaqt rejimida boshqarib, energiya samaradorligini maksimal darajaga yetkazadi.Bunday gibrid tizimlar nafaqat issiqlik almashinuvini yaxshilaydi, balki sovutish jarayonini avtomatlashtiradi, inson omilini kamaytiradi va tizimning uzluksiz ishlashini ta’minlaydi. Tadqiqotlar shuni ko‘rsatadiki, AI asosida boshqariladigan nanofluid sovutish tizimlari an’anaviy sovutish usullariga nisbatan 15–20% gacha energiya tejamkorlik beradi.Kelgusida ushbu yo‘nalish bo‘yicha modellashtirish, eksperimental tekshirish va AI algoritmlarini mahalliy sharoitlarga moslashtirish orqali yanada mukammal tizimlarni ishlab chiqish mumkin. Ayniqsa, O‘zbekistonning issiq iqlim zonalarida bu texnologiyani joriy etish quyosh energetikasining barqaror rivojlanishiga katta hissa qo‘shadi.

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COMPARISON OF YARN TWIST IN A PNEUMOMECHANICAL SPINNING MACHINE

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Anatation. *The transportation of a discrete flow of fibers in rotor spinning was carried out by various methods and the structure of the yarn formed from a fibrous ribbon in a rotor was estimated by experimentally determining the change in the actual value of the twist factor.*

Анатация. *Транспортирование дискретного потока волокон в пневмомеханическом прядении осуществлено различными методами и отсенена структура пряжи, формируемой из волокнистой ленточки вкамере путем эксперименталного определения изменения фактического значения коеффитсиента крутки.*

The twist of yarn formed by pneumomechanical spinning depends on the shape of the cross-section of the sliver formed in the groove of the spinning chamber. The smaller the cross-section of the sliver, the easier it is for the twist to spread at the open end of the thread and reach a longer distance. Since the resistance to the twisting force increases with increasing width of the sliver in the groove of the spinning chamber, the spread of twist at the open end of the yarn occurs at a smaller distance [1]. It should be noted that the open end of the pneumomechanical thread has a wedge-shaped shape, and the length of the end is maintained due to the continuous flow of discrete fibers into it. As a result of the continuous flow of new fibers falling onto the wedge-shaped twisted part of the open end of the pneumatic-mechanical yarn, the fibers in the yarn structure are arranged randomly, that is, the yarn is formed from fibers that are not arranged in parallel. Therefore, determining the actual values of the twist of OE yarn is somewhat more difficult than for ring-spun yarn. However, the twist of OE yarn is also determined based on the instructions available on the twist meter [2].

When the discrete fiber flow is carried out in two ways - in a confusor and a diffuser - the size of the sliver formed in the groove of the spinning chamber is different [3]. When using a confusor, the width of the sliver becomes larger than the width of the sliver obtained when using a diffuser. As a result, the number of twists at the open end during yarn twist formation was also studied at different values of the nominal twist coefficient (from 35 to 57) (Table 1).

The number of practical twists on the twist gauge was determined by the standard method, and the values of the twist coefficients were summarized in Table 1.

Table 1

Nominal and actual twist coefficients of yarn

Discrete fiber flow transport method	Twist coefficient					
	Nominal	35	38	44	1	7
With diffuser	Practical	42	43	45	6	8
Confuser	Practical	36	37	42	9	3

It can be seen that the twist coefficient of the yarn obtained using a confusor is lower than the calculated value, and the difference increases with increasing twist. This is due to a change in the structure of the yarn, i.e., a decrease in the number of fibers in the core yarn [4].

It was found that the practical twist coefficient of the yarn using the diffuser was 42 and 43 instead of 35 and 38 until it reached 45, which was higher than the nominal one, and after 45 it dropped to 46 and 48 instead of 51 and 57. This difference is also explained by the change in structure as a result of the change in the twist distribution distance at the yarn end, as mentioned above.

Conclusion: It has been proven in practice that it is possible to spin yarn with a reduced number of twists using a diffuser.

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