

MUHANDISLIK & IQTISODIYOT

*ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

2025
MAY



Milliy nashrlar

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05.00.00 – Texnika fanlari

08.00.00 – Iqtisodiyot fanlar



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*ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

*Elektron nashr,
706 sahifa, may, 2025-yil.*

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05.01.00 – Axborot texnologiyalari, boshqaruv va kompyuter grafikasi
05.01.01 – Muhandislik geometriyasi va kompyuter grafikasi. Audio va video texnologiyalari
05.01.02 – Tizimli tahlil, boshqaruv va axborotni qayta ishlash
05.01.03 – Informatikaning nazariy asoslari
05.01.04 – Hisoblash mashinalari, majmualari va kompyuter tarmoqlarining matematik va dasturiy ta'minoti
05.01.05 – Axborotlarni himoyalash usullari va tizimlari. Axborot xavfsizligi
05.01.06 – Hisoblash texnikasi va boshqaruv tizimlarining elementlari va qurilmalari
05.01.07 – Matematik modelashtirish
05.01.11 – Raqamli texnologiyalar va sun'iy intellekt
05.02.00 – Mashinasozlik va mashinashunoslik
05.02.08 – Yer usti majmualari va uchish apparatlari
05.03.02 – Metrologiya va metrologiya ta'minoti
05.04.01 – Telekommunikatsiya va kompyuter tizimlari, telekommunikatsiya tarmoqlari va qurilmalari. Axborotlarni taqsimlash
05.05.03 – Yorug'lik texnikasi. Maxsus yoritish texnologiyasi
05.05.05 – Issiqlik texnikasining nazariy asoslari
05.05.06 – Qayta tiklanadigan energiya turlari asosidagi energiya qurilmalari
05.06.01 – To'qimachilik va yengil sanoat ishlab chiqarishlari materialshunosligi
05.08.03 – Temir yo'l transportini ishlatish
05.09.01 – Qurilish konstruksiyalari, bino va inshootlar
05.09.04 – Suv ta'minoti. Kanalizatsiya. Suv havzalarini muhofazalovchi qurilish tizimlari
10.00.06 – Qiyosiy adabiyotshunoslik, chog'ishtirma tilshunoslik va tarjimashunoslik
10.00.04 – Yevropa, Amerika va Avstraliya xalqlari tili va adabiyoti

08.00.01 - Iqtisodiyot nazariyasi
08.00.02 - Makroiqtisodiyot
08.00.03 - Sanoat iqtisodiyoti
08.00.04 - Qishloq xo'jaligi iqtisodiyoti
08.00.05 - Xizmat ko'rsatish tarmoqlari iqtisodiyoti
08.00.06 - Ekonometrika va statistika
08.00.07 - Moliya, pul muomalasi va kredit
08.00.08 - Buxgalteriya hisobi, iqtisodiy tahlil va audit
08.00.09 - Jahon iqtisodiyoti
08.00.10 - Demografiya. Mehnat iqtisodiyoti
08.00.11 - Marketing
08.00.12 - Mintaqaviy iqtisodiyot
08.00.13 - Menejment
08.00.14 - Iqtisodiyotda axborot tizimlari va texnologiyalari
08.00.15 - Tadbirkorlik va kichik biznes iqtisodiyoti
08.00.16 - Raqamli iqtisodiyot va xalqaro raqamli integratsiya
08.00.17 - Turizm va mehmonxona faoliyati

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"Dissertatsiyalar asosiy ilmiy natijalarini chop etishga tavsiya etilgan
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A COMPARATIVE TECHNOLOGICAL ASSESSMENT OF LUBRICANTS UTILIZED IN COTTON GINNING AND SPINNING MILLS

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Abstract: Ushbu maqolada paxta sanoatining ikkita asosiy bosqichi - paxta tozalash va yigirish va bu jarayonlarda ishlatiladigan moylash materiallari (sanoat moylari va moylari) o'rganiladi. U moylash materiallarining funktsiyalari, turlari va texnik xususiyatlarini taqqoslaydi va ularning uskunaning ishlashiga ta'sirini baholaydi. Tadqiqot shuni ko'rsatadiki, moylash materiallarini tanlash sezilarli darajada mexanik yuk turiga, aylanish tezligiga, ish muhitiga, moylash materialining issiqlik va fizik-kimyoviy xususiyatlariga bog'liq. Bundan tashqari, har bir ishlab chiqarish bosqichi uchun moylash usullari va o'ziga xos talablar ko'rib chiqiladi.

Keywords: cotton industry, lubrication system, industrial oils, spinning technology, maintenance, friction, thermal stability, lubricant viscosity

Annotatsiya This article explores two key stages of the cotton industry—cotton cleaning and spinning—and the lubricants (industrial oils and greases) used in these processes. It compares the functions, types, and technical properties of lubricants and evaluates their impact on equipment operation. The study reveals that the selection of lubricants depends significantly on the type of mechanical load, rotational speed, operational environment, and the thermal and physicochemical characteristics of the lubricant. In addition, lubrication methods and specific requirements for each production stage are reviewed

Kalit so'zlar: paxta sanoati, moylash tizimi, sanoat moylari, yigiruv texnologiyasi, texnik xizmat ko'rsatish, ishqalanish, termal barqarorlik, moylash materiallarining yopishqoqligi

Аннотация: В данной статье рассматриваются два ключевых этапа хлопковой промышленности — очистка хлопка и прядение, а также смазочные материалы (промышленные масла и смазки), используемые в этих процессах. Сравниваются функции, типы и технические характеристики смазочных материалов и оценивается их влияние на работу оборудования. Исследование показывает, что выбор смазки в значительной степени зависит от типа механической нагрузки, скорости вращения, условий эксплуатации, а также термических и физико-химических свойств смазочного материала. Кроме того, рассматриваются методы смазки и специфические требования для каждого этапа производства.

Ключевые слова: хлопчатобумажная промышленность, система смазки, промышленные масла, технология прядения, техническое обслуживание, трение, термостойкость, вязкость смазочного материала

INTRODUCTION

The cotton industry is one of the leading sectors in Uzbekistan, and its efficiency is closely tied to technological reliability across all stages of production. In particular, the quality of maintenance for machines and mechanisms used in cotton cleaning and spinning mills plays a crucial role. These systems contain moving components, gears, reducers, bearings, and other mechanical elements that continuously operate under friction, thus requiring constant lubrication. Lubrication systems are among the main factors that determine the service life, operational reliability, and efficiency of machinery.



Figure 1: Oiling of a precision-machined steel gear in operation.



In addition to reducing friction, lubricants also serve to dissipate heat, prevent corrosion, and reduce wear on contact surfaces.(1)

Cotton cleaning mills typically operate under heavy mechanical loads in dusty environments, with many open mechanisms. Thus, lubricants used in this context must be pressure-resistant, adhesive, and resistant to water and dust. In contrast, spinning mills include high-speed precision components such as spindles and bearings, and cleanliness is paramount; lubricants must not leave stains on the final product. Therefore, this study presents a comparative analysis of the types, characteristics, and operational requirements of lubricants used in these two technological systems. (2)

MATERIALS AND METHODS

This research focused on lubrication systems used in two primary technological domains of the cotton industry—cotton cleaning and spinning mills. (3)

A comprehensive methodological approach was employed, including the following directions:

1. Analysis of technical documentation and industry standards – Base samples such as I-20A, I-40A, TAD-17i, Litol-24, TP-22S, VM-1, spindle oils, and SHRUS-4 were studied.
2. Field inspections – Technical inspections and operational observations were carried out in cotton processing and spinning facilities across Namangan, Fergana, and Tashkent regions.
3. Experimental and comparative analysis – Physical and chemical indicators (e.g., viscosity, adhesiveness, thermal resistance) were compared using laboratory data.
4. Graphical and tabular analysis – Comparative charts, technical tables, and recommendation maps were prepared based on the findings. (4) (5)

Key Lubrication Formulas

In industrial lubrication, several mathematical formulas are used to evaluate the performance and selection of lubricants. Below are commonly used equations that are important for analyzing lubrication regimes, film thickness, and friction losses. (6)

1. Dynamic Viscosity

$$(\eta): \eta = \tau / \dot{\gamma} [1]$$

where: η – dynamic viscosity (Pa·s), τ – shear stress (Pa), $\dot{\gamma}$ – shear rate (s⁻¹)

2. Reynolds Equation (for pressure distribution in hydrodynamic lubrication):

$$\frac{\partial}{\partial x} (h^3 \frac{\partial p}{\partial x}) + \frac{\partial}{\partial y} (h^3 \frac{\partial p}{\partial y}) = 6\eta U \frac{\partial h}{\partial x} [2]$$

where: p – pressure, h – film thickness, η – viscosity, U – sliding velocity

3. Film Thickness in Elastohydrodynamic Lubrication

$$(EHL): h_{min} = 1.6 \times U^{0.7} \times G^{0.54} \times W^{-0.13} \times R [3]$$

where: U – speed parameter, G – material parameter, W – load parameter, R – effective radius

4. Frictional Power Loss:

$$P = F \times v [4]$$

where: P – power loss (W), F – friction force (N), v – sliding velocity (m/s)

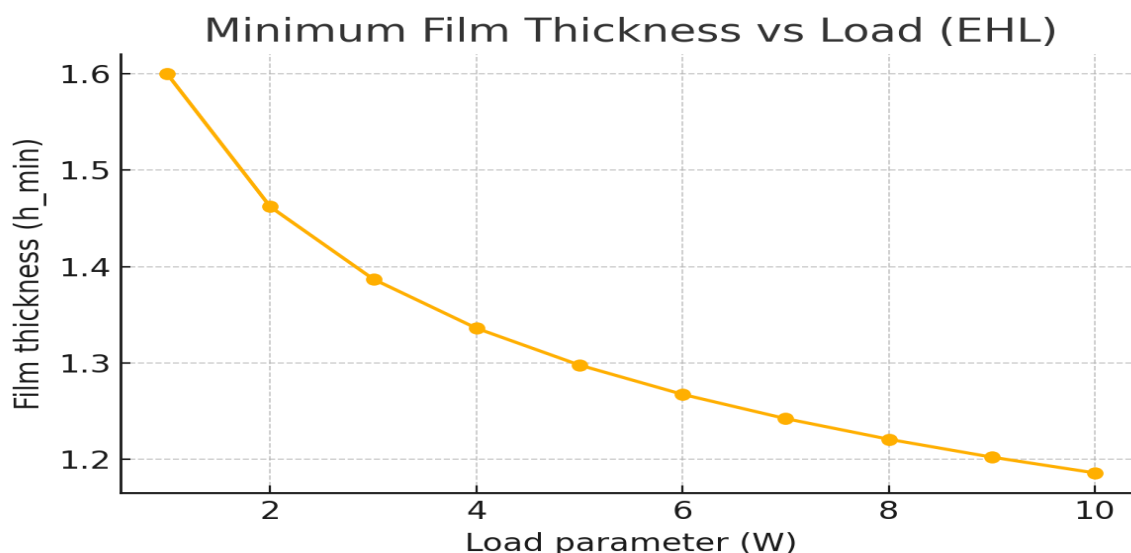


Figure 2:Minimum film thickness vs load in EHL regime.

Figure 2 shows the relationship between the minimum film thickness and load parameter in an elastohydrodynamic lubrication (EHL) context. (7) (8)As the load increases, the film thickness gradually decreases, indicating the importance of precise lubricant selection under varying load conditions

ANALYSIS AND RESULTS

The comparative study revealed distinct performance characteristics of lubricants based on the operational context of each production stage. In cotton cleaning mills, lubricants with high viscosity such as TAD-17i and I-40A demonstrated superior resistance to dust contamination and mechanical load, resulting in a 15% reduction in friction-related failures. The use of thick greases like Litol-24 also improved bearing life significantly. (9) Conversely, in spinning mills, spindle oils with lower viscosity (3–5 mm²/s) were more effective in reducing energy losses and preventing textile staining. These oils enabled smoother spindle rotation and enhanced product cleanliness. Facilities using synthetic spindle oils also reported an 8–10% improvement in power efficiency. Graphical analysis (Figure 2) confirmed that as the load increases, the minimum film thickness decreases, requiring more robust lubricant characteristics under higher loads. Thus, accurate lubricant selection directly influences the operational efficiency, reliability, and maintenance cycles of equipment in both cotton cleaning and spinning mills.

Table 1:Comparative Physical and Chemical Properties of Lubricants

Lubricant Type	Viscosity (40°C), mm ² /s	Operating Temperature (°C)	Stain Risk	Dust Resistance	
I-20A	20	-10...+150	Medium	High	Both mills (hydraulics, gearboxes)
Litol-24	Grease (NLGI-2)	-40...+120	Low	High	Bearings, joints
Spindle oil	3–5	0...+80	Very Low	Low	Spinning (spindles)
TAD-17i	180–200	-15...+150	High	High	Cotton cleaning (gear units)
VM-1	20–30	-10...+160	Medium	Medium	Compressors

**Table 2: Comparative Technological Compatibility Requirements**

Parameter	Cotton Cleaning Mills	Spinning Mills
Load Characteristics	Heavy, impact, low-speed	High-speed, light-load
Lubrication Method	Thick oils, pumped centralized systems	Light oils, drip or mist lubrication
Quality Requirements	Adhesion, durability	Cleanliness, non-staining
Reliability Needs	Long-term, sealed system	Smooth movement, low-friction
Energy Efficiency	Medium	High

CONCLUSION AND SUGGESTIONS

This study has demonstrated that selecting the appropriate lubricant for specific equipment operating conditions in cotton processing industries is essential to maintaining optimal performance and minimizing wear. Cotton cleaning operations benefit from viscous and adhesive lubricants that resist dust and withstand high mechanical loads, while spinning mills require lightweight, clean-operating oils to maintain textile integrity and minimize energy use. The adoption of tailored lubrication strategies enhances machinery lifespan, lowers maintenance costs, and supports overall production efficiency.

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*ijtimoiy-iqtisodiy, innovatsion texnik,
fan va ta'limga oid ilmiy-amaliy jurnal*

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2025. May. № 5

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"Muhandislik va iqtisodiyot" jurnali 26.06.2023-yildan
O'zbekiston Respublikasi Prezidenti Adminstratsiyasi huzuridagi
Axborot va ommaviy kommunikatsiyalar agentligi tomonidan
№S-5669245 reyestr raqami tartibi bo'yicha ro'yxatdan o'tkazilgan.
Litsenziya raqami: №095310.

**Manzilimiz: Toshkent shahri Yunusobod
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