TRIBODIZAJN KAO KONCEPT

Slobodan Mitrović. dipl. ing.
Mašinski fakultet u Kragujevcu

Principi namenjeni novim kao i poboljšanju starim konstrukcionim rešenjima triboloških elemenata pa i čitavih tribomehaničkih sistema, zasnovani na sagledavanju i analizi triboloških parametara, nagoveštavaju novu disciplinu pod nazivom TRIBODESIGN, kod nas, takođe, prihvaćen kao TRIBODIZAJN.

Veza između tribologije i tribodizajna je neposredna uprkos problemima koji su prisutni u slaboj komunikaciji između tribologa i konstruktora. Jedna od novih oblasti u kojoj tribologija ima značajan udeo je tribodizajn savremenih mašinskih konstrukcuja.

Ključne reči: *Tribologija, konstruisanje, tribodizajn*

Suštinski problem s kojim se danas suočava razvoj tehnike proističe iz veoma izraženog raskoraka između stepena razvoja tribologije kao nauke i tehnologije i stepena njene praktične primene. Zbog toga se u svetu poklanja izuzetna pažnja inplementaciji triboloških znanja još u fazi konstruisanja tribomehaničkih sistema. Taj kompleksni pristup u ovom trenutku objedinjen je pojmom tribodizajna.

Pojam tribologije je u poslednjoj trećini dvadesetog veka postao jedan od osnovnih pojmova tehnike, koji se posebno popularisao u oblastima konstruisanja i projektovanja. Taj novo prihvaćeni pojam tribologije, koji nije baš sveobuhvatan jer ne obuhvata sve vrste mehaničkog habanja kao što su erozija, kavitacija i ostale oblike habanja uzrokovane tečenjem materijala, iskorišćen je za građenje opšte prihvaćene kovanice kao tribodizajn.

Očigledna i osnovna činjenica je da krajnji cilj tribologije leži u njenoj uspešnoj inplementaciji u konstruisanju raznih mašina. Najprikladniji oblik ove primene je tribodizajn koji predstavlja granu konstruisanja mašina koja uzima u obzir sve mašinske elemente kod kojih trenje, habanje i podmazivanje imaju posebnu ulogu.

U nameri da se integrišu tribologija i tribodizajn u konstruisanju mašina i mašinske tehnike, poželjno je započeti sagledavanjem inženjerskog zadatka najpre uopšteno, a zatim ići na detaljno sagledavanje konkretnog zadatka mašinskog konstruisanja. Zadatak konstruktora se sastoji u kontroli toka unutrašnjih sila, energije i materije, uključujući svaku kombinaciju i interakciju pomenutih vrsta različitih tokova. Rezultat pretvaranja energije iz jednog oblika u drugi predstavlja kinetičku energiju koja prouzrokuje kretanje. Kretanje takođe igra ulogu kada nije toliko važna kinetička energija koliko kontrola promene pozicije nekog elementa u toku vremena. Kretanje je takođe bitno pri pretvaranju mehaničke energije u termičku u obliku toplote stvorene pri trenju.

Određena slična dejstva su takođe važna u tribologiji, a posebno u tribodizajnu. Na primer, sa današnje tačke gledišta, habanje može biti predstavljeno kao neželjeni tok materijala. Taj tok materijala treba održavati u određenim granicama, posredstvom kontrole tokova sila i energije, prvenstveno toplote koja nastaje trenjem, a posebno tamo gde sile i energija mora da prođu kroz kontaktnu površinu oštećenu habanjem.

U tribodizajnu treba razlikovati dva ključna principa; princip predviđanja dodira između kontaktnih površina i princip primene sredstava za podmazivanje, koja igraju ulogu inženjerskog materijala. U predstojećem radu čini se osvrt na prvopomenuti princip kao najvažniji.

Princip predviđanja dodira ima za cilj da spreči rizik od preopterećenja površinskog materijala tela u kontaktu, ili drugačije rečeno da spreči rizik od mehaničkog habanja. Ovaj princip je najvažniji u tribodizajnu i može se tretirati na više načina. U vezi sa gledišta optimalnog grupisanja triboloških funkcija javlja se potreba za zaštitom kontaktnih površina posredstvom posebnih prevlaka. Takve prevlake služe za zaštitu njihovih podloga od habanja. Zaštitno delovanje može biti usmereno ka cilju smanjenja kontaktnog pritiska, korišćenjem relativno mekog tela za prevlaku ili oblogu, čime se smanjuje rizik od preopterećenja dodirne površine. Nanošenjem zaštitnih prevlaka u različitim oblicima ulazi se u realizaciju principa zaštite kontakta. Zaštitna funkcija pripada prevlaci dok jačinu strukture kontakta obezbeđuje osnovni materijal. U suštini, osnovni materijal često služi kao podloga slabijem materijalu prevlake ili zaštitne obloge i tako sprečava dalje prenošenje spoljašnjeg opterećenja. Pošto zaštitna prevlaka igra ulogu posrednika pri protoku sile ista mora biti projektovana tako da izvrši prenos opterećenja prema osnovnom materijalu

Na osnovu izloženog može se zaključiti da se od inženjera, koji je odgovoran za tribodizajn, bilo kog tribološkog sistema, mora očekivati da može da analizira situaciju sa kojom je suočen i da odgovarajućim znanjem doprinese rešavanju konkretnog problema. Ovakva shvatanja su razumljiva ako se imaju u vidu zahtevi za visokom pouzdanošću i ekonomičnošću konstrukcije.

Uključivanje osnovnih principa tribologije i tribodizajna, u proces inženjerskog projektovanja, ne predstavlja neko posebno edukaciono opterećenje jer su osnovni principi proučavanja materije uključeni u predmete svakog inženjerskog kursa, kao što su dinamika fluida, termodinamika, mašinski materijali, mašinski elementi sa konstruisanjem, mašine alatke i dr.

LITERATURA:

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TRIBODESIGN AS A CONCEPT

Slobodan.Mitrović[1)]

[1)] *Faculty of Mechanical Engineering, Kragujevac, Yugoslavia*

Principles aimed for the new and improvement of the old construction solutions of tribological elements, as well as the whole tribomechanical systems, based on considering and analysis of tribological parameters, are announcing the new discipline named TRIBODESIGN, the name also accepted in our country.

The connection between tribology and tribodesign is direct, despite problems that are present in poor communication between tribologist and designer. One of the new areas in which tribology has a significant share is tribodesign of machine constructions.

Keywords: Tribology, design, tribodesign.

The essential problem that the development of technology is confronting with today stems from the very prominent discord between the development degree of tribology as a science and technology and degree of its practical application. Due to that, in the world is a great attention devoted to implementation of tribological knowledge, already in the phase of the tribomechanical systems design. That complex approach is, at this moment, united as the notion called tribodesign.

The notion of tribology has, in the last third of the twentieth century, become one of the fundamental notions in technique, which has become especially popular in areas of construction and design. That, newly accepted notion of tribology, which is not general, since it does not include all types of mechanical wear, like erosion, cavitation and other forms of wear caused by material flow, was used for building the generally accepted new word like tribodesign.

Obvious and fundamental fact that the final objective of tribology lies in its successful implementation in construction of different machines. The most convenient form of this application is tribodesign, which represents a branch of machine constructions that is taking into account all machine elements where friction, wear and lubrication have special roles.

In order to integrate tribology and tribodesign in constructions of machines and machine technique, it is desirable to start with comprehension of the engineering task at first generally, and then moving on to detailed understanding of the concrete task of machine design. The designer´s task consists of flow control of the inner forces, energy and mater, including all the combinations and interactions of the mentioned different types of flows. Result of the energy conversion from one to the other form represents the kinetic energy that causes motion. The motion also plays a role when kinetic energy is not as important as control of the position change of some element in time. Motion is also essential during the mechanical energy conversion into thermal energy in the form of heat created during friction.

Certain similar properties are also important in tribology, especially in tribodesign. For instance, from nowadays point of view, wear can be represented as the undesired material flow. That material flow should be kept within certain limits, by means of controlling the flows of force and energy, primarily heat generated by friction, and especially there where forces and energy can pass through the contact surface damaged by wear.

In tribodesign, one should differentiate between two essential principles: principle of contact prediction between the contact surfaces, and the principle of application of cutting fluids, that are playing the role of engineering material. In the following work, the consideration is performed of the first of these two principles, as the most important one.

The principle of contact prediction has as an objective to prevent a risk of overloading of the surface material of bodies in contact, or in other words, to prevent a risk of mechanical wear. This principle is the most important in tribodesign, and it can be treated in several ways. In regard with the viewpoint of optimal grouping of tribological functions, the necessity appears for the contact surface protection by special coatings. Such coatings serve as a protection of their substrate materials against wear. The protective action can be aimed to the goal of reducing the contact pressure, by application of relatively soft body for coating or layer, what decreases the risk of contact surface overloading. By deposition of protective coatings in different forms, one enters into realization of the contact protection principle. The protective function belongs to the coating, while the strength of the structure is provided by the substrate material. Essentially, the substrate material frequently serves a base to the softer material of the protective coating or layer, and thus it prevents further transmission of the outside load. Since the protective coating plays a role of the intermediary in force flow, tit has to be designed so that it can perform the transmission of load towards the base material.

Based on all the presented, it can be concluded that from an engineer, which is responsible for tribodesign of any tribological system, must be expected to be able to analyze the situation with which he is confronted, and, with adequate knowledge, to contribute to solving of the concrete problem. Such assumptions are understandable, if one keeps in mind requirements for high reliability and economic efficiency of a construction.

Introducing of the fundamental principles of tribology and tribodesign into the process of engineering design does not represent some special educational burden, since the basic principles of studying of this matter, are already incorporated into subjects of every engineering curriculum, like fluid dynamics, machine materials, machine elements with design, machine tools, etc.

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