Shor bo‘yicha qattiqlikni aniqlash usuli va uning elastomer materiallarni baholashdagi ahamiyati

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Annotatsiya. Mazkur tezis elastomer va polimer materiallarning muhim mexanik tavsiflaridan biri bo'lgan Shore qattiqligini aniqlash usulini o'rganishga bag'ishlangan. Ishda Shore qattiqligini o'lchashning nazariy asoslari, uning ishlash prinsipi hamda Shore A va Shore D shkalalarining qo'llanilish sohalari batafsil tahlil qilingan. Elastomer materiallarning deformatsiyalanish xususiyatlari, kontakt maydonining shakllanishi, ishqalanish va yeyilish jarayonlari qattiqlik ko'rsatkichiga bevosita bog'liq ekanligi ilmiy adabiyotlar asosida yoritilgan. Shuningdek, Shore usulida qo'llaniladigan durometrning tuzilishi, o'lchash metodikasi hamda sinov natijalariga ta'sir etuvchi omillar tahlil qilingan. Tadqiqot davomida Shore qattiqligining elastomer materiallarning mexanik, tribologik va ekspluatatsion xususiyatlarini baholashdagi ahamiyati ko'rsatib berilgan. Mazkur usul material sifatini nazorat qilish, ishlab chiqarish jarayonlarini optimallashtirish hamda turli sanoat tarmoqlarida qo'llaniladigan elastomer buyumlarning ishonchliligi va xizmat muddatini oshirishda muhim vosita hisoblanadi. Olingan natijalar Shore qattiqligini aniqlash usulining sodda, tezkor va ishonchli sinov usullaridan biri ekanligini tasdiqlaydi hamda elastomer va polimer materiallarni tanlash va baholashda undan samarali foydalanish mumkinligini ko'rsatadi.Kalit so‘zlar: Shore qattiqligi, durometr, elastomer, polimer, Shore A, Shore D, qattiqlik, ishqalanish, tribologiya, deformatsiya.

Kalit so‘zlar: Qattiqlik, Indetor, Shor qattiqlik, plasmassa, rezina, silikon, elastomer va kauchuk

Thesis on the topic:” **Determination of Shore Hardness**”

Annotation. This thesis is devoted to the investigation of the Shore hardness test, which is one of the most important methods for evaluating the mechanical properties of elastomeric and polymeric materials. The theoretical principles of Shore hardness measurement, the operating mechanism of the durometer, and the application fields of the Shore A and Shore D scales are discussed in detail. Particular attention is paid to the relationship between hardness and the mechanical and tribological behavior of elastomers, including contact deformation, friction, wear resistance, and load-bearing capacity. The study also examines the testing procedure, the factors influencing measurement accuracy, and the advantages of Shore hardness testing compared with other hardness evaluation methods. The obtained analysis demonstrates that Shore hardness is an essential parameter for assessing the quality, durability, and service performance of elastomeric products used in automotive engineering, robotics, biomedical devices, sealing systems, and various industrial applications. Owing to its simplicity, rapid testing procedure, and standardized methodology, the Shore hardness test has become one of the most widely accepted techniques for quality control of polymeric materials. The results confirm that Shore hardness provides reliable information about the mechanical performance of elastomers and serves as an effective criterion for material selection, product design, and engineering applications.

Key words: Hardness, Indenter, Shore Hardness, Plastic, Rubber, Silicone, ElastomerNatural Rubber (yoki Caoutchouc)

Bugungi kunda elastomer va polimer materiallar mashinasozlik, avtomobilsozlik, tibbiyot, robototexnika hamda boshqa ko‘plab sanoat tarmoqlarida keng qo‘llanilmoqda. Ushbu materiallarning

ekspluatatsion xususiyatlarini baholashda eng muhim ko‘rsatkichlardan biri ularning qattiqligi hisoblanadi. Qattiqlik materialning tashqi kuch ta’sirida deformatsiyaga qarshilik ko‘rsatish qobiliyatini ifodalaydi.Elastomerlar uchun metallarda qo‘llaniladigan Brinell, Rokvell yoki Vikkers usullaridan foydalanish maqsadga muvofiq emas. Shu sababli yumshoq materiallarning qattiqligini aniqlashda maxsus Shore usuli ishlab chiqilgan. Ushbu usul sodda, tezkor va yuqori takrorlanuvchanlikka ega bo‘lib, elastomerlarning sifatini nazorat qilishda xalqaro standartlardan biri hisoblanadi.Shore qattiqligi maxsus durometr yordamida aniqlanadi. O‘lchash jarayonida prujina yordamida yuklangan uch (indenter) material yuzasiga bosiladi va uning botish chuqurligi bo‘yicha qattiqlik qiymati aniqlanadi. Material qanchalik qattiq bo‘lsa, indenterning botish chuqurligi shunchalik kichik bo‘ladi va Shore qattiqligi yuqori qiymatga ega bo‘ladi.Shore qattiqligi odatda 0 dan 100 gacha bo‘lgan birliklarda ifodalanadi. Qiymatning ortishi materialning deformatsiyaga nisbatan yuqori qarshilikka ega ekanligini bildiradi.

Elastomer va polimer materiallar uchun asosan ikkita shkala qo‘llaniladi:

Shore A – yumshoq rezinalar, silikonlar, elastomerlar va kauchuk materiallar uchun;

Shore D – qattiq plastmassalar, qattiq polimerlar va kompozit materiallar uchun.

Masalan, avtomobil shinalari odatda 60–75 Shore A oralig‘ida, silikon materiallar 20–50 Shore A oralig‘ida, qattiq plastiklar esa 70–90 Shore D diapazonida bo‘ladi. Material qattiqligi uning ishqalanish va yeyilish xususiyatlariga bevosita ta’sir ko‘rsatadi. Yumshoq elastomerlar kontakt yuzasiga yaxshi moslashadi va katta haqiqiy kontakt maydoni hosil qiladi. Natijada adgeziya kuchayadi va ishqalanish koeffitsiyenti odatda yuqoriroq bo‘ladi.Qattiqlik oshgani sari materialning deformatsiyalanishi kamayadi, kontakt maydoni kichrayadi va ishqalanish koeffitsiyenti pasayishi mumkin. Shu bilan birga, juda qattiq materiallar mo‘rtlashib, zarba yuklamalariga nisbatan sezgirroq bo‘lishi mumkin.Shuning uchun elastomer materiallarni tanlashda Shore qattiqligi muhim parametr hisoblanadi. Robot ushlagichlari, muhrlar, amortizatorlar va biomateriallarni loyihalashda aynan kerakli Shore qiymatiga ega materiallardan foydalaniladi.

Shore usuli quyidagi afzalliklarga ega:

- o‘lchash jarayoni sodda va tez bajariladi;
- namunaga deyarli zarar yetkazmaydi;
- yuqori aniqlik va takrorlanuvchanlikka ega;
- xalqaro standartlarga mos ravishda amalga oshiriladi;
- sanoat korxonalarida sifat nazoratida keng qo‘llaniladi.

Bundan tashqari, Shore qattiqligi natijalari elastiklik moduli, deformatsiyalanish qobiliyati va tribologik parametrlarni baholash uchun dastlabki ma’lumot sifatida xizmat qiladi.Shore usuli elastomer va polimer materiallarning qattiqligini aniqlashning eng qulay va ishonchli usullaridan biridir. Ushbu usul yordamida materiallarning mexanik xususiyatlari tezkor baholanadi hamda ularning ekspluatatsion xatti-harakatlari oldindan prognoz qilinadi. Shore qattiqligi kontakt maydoni, deformatsiyalanish darajasi, ishqalanish koeffitsiyenti va yeyilish jarayonlariga sezilarli ta’sir ko‘rsatadi. Shu sababli elastomer materiallarni loyihalash, tanlash va sifatini nazorat qilishda Shore qattiqligi muhim mezonlardan biri hisoblanadi.

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