

Universal xarakteristikalaridan foydalanib dvigatelning ish hajmini o'zgartirish orqali uni boshqarishda samaradorlik ko'rsatkichlarini tadqiq etishning hisob-eksperimental usuli

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Annotatsiya: Ushbu maqolada universal xarakteristikalaridan foydalanib dvigatelning ish hajmini o'zgartirish orqali uni boshqarishda samaradorlik ko'rsatkichlarini tadqiq etishning hisob-eksperimental usuli to'g'risida batafsil ma'lumot berilgan.

Kalit so'zlar: dvigatel, ish hajmi, boshqarish, hisob-eksperimental usul

An experimental method for studying the efficiency of control of the engine by changing the capacity of the engine using universal characteristics

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Abstract: This article provides detailed information on the computational-experimental method of studying the efficiency of driving an engine by changing its operating capacity using universal characteristics.

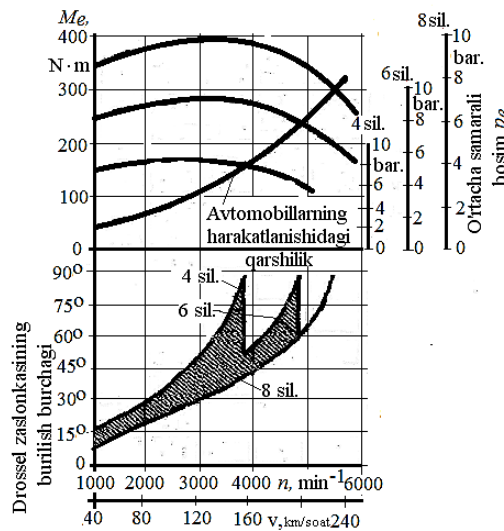
Keywords: engine, workload, control, computational-experimental method

Dvigatel ish hajmini o'zgartirish orqali uni boshqarish usulining samaradorligi bo'yicha ishonchli natijalarni albatta, eksperimental tadqiqotlar orqali olinadi. Biroq, ularni amalga oshirilishi anchayin qimmat bo'lishi, murakkab va uzoq muddat talab etilishi tufayli, usulni qo'llashning maqsadga muvofiqligini oldindan baholash kerak bo'ladi.

To'la hajmdagi va silindrlarining bir qismi o'chirilgan digatellarning tezlik xarakteristikalari 2.2.1-rasmda tasvirlangan [74].

Shuni ta'kidlash kerakki, xoh alohida silindr xoh to'la hajmli dvigatel silindrlari teng yuklama oladigan bo'lsa o'rtacha samarali bosim (p_e) qiymati qo'llanilgandagi kabi silindrlarni o'chirilganda o'rtacha samarali bosim (p_e) ordinatalarini qo'llash o'zining fizik mohiyatini yo'qotadi. Dvigatel silindrlarining bir qismini o'chirishda u ishlab chiqargan momentni, quvvatni va bajarilgan ishlarni saqlab turishi lozim, bunda dvigatelni solishtirma bajargan ishi ordinatasi ($L_{y\Delta}$) yordamida ko'rsatkichlarni (masalan, samaradorlikni) taqqoslash amalga oshiriladi [2, 11, 29, 39, 47, 56, 63].

Solishtirma bajarilgan ish dvigatel to'la hajmining ($L_{\text{полн}}$) ushbu dvigatel silindrlari bir qismi o'chirilgandagi aktiv ishlayotgan silindrlarining umumiy hajmiga nisbatini anglatadi. Dvigatelni boshqarish vaqtida uning ish hajmi i dan z gacha ishlayotgan faol silindrlar soniga qarab o'zgaradi.



2.2.1-rasm. Daimler-Benz ($i \cdot V_h = 5 \text{ L.}$) firmasining V-simon benzinli dvigatelni sakkiz, olti va to'rtta silindrlar bilan uni boshqarishdagi (yoqilg'i uzatishni o'chirish va klapanlarni yopiq holatida to'xtatib qo'yish) ish jarayoni xarakteristikalari [74].

$$L_{y\text{д}} = L_{\text{полн.}} / (i \cdot V_h), \text{ J/dm}^3 \quad (2.6)$$

To'la hajmli dvigatel uchun

$$L_{y\text{д}} = L_{\text{полн.}} / (z \cdot V_h), \text{ J/dm}^3 \quad (2.7)$$

Silindrlarining bir qismi o'chirilgan dvigatel ya'ni faol silindrlarining soni z ga teng bo'lgan dvigatellar uchun

$$L_{\text{полн.}} = 500 \cdot p_e \cdot i \cdot V_h, \text{ J.} \quad (2.8)$$

2.2.2-rasmda ko'rsatilganlarga muvofiq, o'rtacha samarali bosim (p_e) ordinatalarini yoki qo'shimcha ravishda solishtirma bajarilgan ish ($L_{y\text{д}}$) ordinatasi o'zgartiriladi. Bu usulda aynan ushbu ko'rsatkich boshqariluvchi (dvigatelning boshqariluvchi ish hajmi - faol silindrlar ish hajmlarining yig'indisi) hisoblanadi.

Dvigatelning universal xarakteristikalari effektiv moment (Me) hamda chastota (n) Bu holatda (Me orqali) dvigatelning to'la ish hajmi quyidagi formula bilan aniqlanadi:

$$L_{\text{полн.}} = 2 \cdot \pi \cdot Me \cdot n, \text{ J.} \quad (2.9)$$

Solishtirma ish esa quyidagicha bo'ladi

$$L_{y\text{д}} = 2 \cdot \pi \cdot Me / z \cdot V_h, \text{ J/dm}^3, \quad (2.10)$$

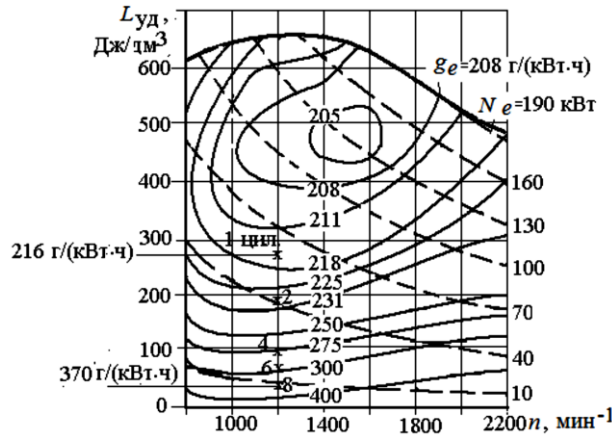
Bu yerda z - faol (ishlayotgan) silindrlar soni; V_h - bitta silindrning ish hajmi, dm^3 [39, 45, 47].

КаМАЗ - 7406 ($V_h = 1,36 \text{ dm}^3$, $i \cdot V_h = 10,85 \text{ dm}^3$) dizelining barcha faol ishlayotgan sakkiz silindri kichik yuklamalarda ($n = 1200 \text{ min}^{-1}$ da $Me_8 = 80 \text{ N}\cdot\text{m}$ effektiv burovchi moment bilan) ishlayotgan bo'lsin. Ushbu dizel dvigatelining to'la

hajmli ish jarayonida (ya'ni faol ishlayotgan silindrlar soni $i=8$) bajaradigan to'la ishi quyidagiga teng bo'ladi:

$$L_{\text{ПОЛН}} = 2 \cdot \pi \cdot Me = 2 \cdot \pi \cdot 80 = 503 \text{ J. (2.11)}$$

Ushbu rejimda huddi shu digatelning ishlayotgan barcha i silindrlarining solishtirma bajargan ishi quyidagi qiymatni tashkil etadi



2.2.2-rasm. $n = 1200 \text{ min}^{-1}$ va bir xil kichik yuklamalarda (to'la yuklamaning 10 % miqdorida) sakkiz silindrli КамАЗ-7406 dizel dvigatelini faol ishlayotgan silindrlari soni $z = 8, 6, 4, 2, 1$ bo'lganda, $L_{\text{уд}} - n : X$ koordinatalari bo'yicha uning universal xarakteristikalarini qurish [11, 47].

$$L_{\text{уд}} = L_{\text{ПОЛН}} / (i \cdot Vh) = 46,3 \text{ J/dm}^3 \text{ (2.12)}$$

Ushbu holatda $g_e = 370 \text{ g/(kWsoat)}$ (2.2.2-rasm). Ushbu dizel dvigatelining faol ishlayotgan silindrlari soni $z = 6, 4, 2$ bo'lganda, bir xil rejimda (bir xil aylanishlar chastotasi va tashqi yuklama bo'yicha) uning yoqilg'i sarfi qanday bo'lishini baholaymiz.

Dvigatelni faol silindrlari soni $z < i$ bo'lganda ham, uning to'la bajargan ishi (503 J) bilan bir xil ish bajarishi kerak. Ushbu barcha holatlarda dvigatel 80 N·m qiymatdagi burovchi momentni (Me) hosil qiladi, ya'ni to'la yuklamaning 10% ni tashkil etadi.

Natijada:

$$z = 6 \text{ bo'lganda, } L_{\text{уд.6}} = 503 / (1,36 \cdot 6) = 503 / 8,16 = 61,6 \text{ J/dm}^3; \text{ (2.13)}$$

$$z = 4 \text{ bo'lganda, } L_{\text{уд.4}} = 503 / (1,36 \cdot 4) = 503 / 5,44 = 92,5 \text{ J/dm}^3; \text{ (2.14)}$$

$$z = 2 \text{ bo'lganda, } L_{\text{уд.2}} = 503 / (1,36 \cdot 2) = 503 / 2,72 = 185 \text{ J/dm}^3; \text{ (2.15)}$$

Universal xarakteristikalardan (2.2.2 - rasmda keltirilgan) foydalanib, turli xil miqdordagi aktiv silindrlar sonida (buni natijasida dvigatelni turli xil solishtirma bajargan ishi) dvigatelning solishtirma effektiv yoqilg'i sarfi hamda quyidagi munosabat orqali aniqlanadigan solishtirma yoqilg'i sarfining kamayishini topamiz:

$$\Delta g_e = [(g_{e8} - g_{ez}) / g_{e8}] \cdot 100\% \text{ (2.16)}$$

Dvigatelni ushbu rejimda bitta silindrda ishlash imkoniyati mexanik FIK orqali indikator ko'rsatkichlarini qayta hisoblash bilan tekshiriladi.

Universal (ko'p parametrlil) xarakteristikalarni qurish uchun eksperimentlar orqali yoki hisob-kitob yo'li bilan olingan natijalar bo'yicha olingan ko'pgina yuklama

xarakteristikalaridan foydalaniladi. Dvigatelning yuklamalar xarakteristikalarini qurish usullari adabiyotlarda keltrilgan (masalan, [8]). Ushbu ishda eksperimental usulda olingan natijalardan foydalanilgan. Shuning uchun ushbu qo'llanilgan usulni dvigatelning ish rejimlarini va uni boshqarishni matematik modellashtirishning hisob-eksperimetal usuli deb ataladi.

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