BIOGAZ QURILMALARIDA KECHAYOTGAN KO'P HOLATLI JARAYONNING MODELI

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Annotatsiya. *Ushbu maqolada biogaz qurilmalarida kechayotgan ko'p holatli jarayonlarning modeli tuzilgan. Biogaz qurilmalarida kechayotgan jarayonni matematik modelini tuzishda o'zaro bog'liqlik elementlar orasidagi bog'lanish munosabatlari alohida keltirib o'tilgan. Biogaz qurilmasining har bir ishchi qismlarini umumlashtirishning miqdoriy darajasi tizimlardagi qism bo'laklari sonini tavsiflaydigan jamlanish darajasi aniq formulasi tuzilgan va shunga o'xshash bir qancha yangiliklar yaratilgan.*

Kalit so'zlar: *jarayon, biogas, model, daraja, xom-ashyo, jamlanish darajasi,oqim, koeffisiyent,algoritm, tizim, modellashtirish, korrelyatsiya*.

МОДЕЛЬ МНОГОСОСТОЯННОГО ПРОЦЕССА В БИОГАЗОВЫХ УСТАНОВКАХ

Аннотация. *В данной статье создана модель многостадийных процессов, протекающих в биогазовых установках. При создании математической модели процесса, происходящего в биогазовых установках, отношения связи между элементами взаимозависимости упоминаются отдельно. Создан количественный уровень обобщения каждой рабочей части биогазовой установки, точная формула уровня обобщения, описывающая количество частей в системах, создан ряд подобных нововведений.*

Ключевые слова: *процесс, биогаз, модель, уровень, сырье, уровень концентрации, расход, коэффициент, алгоритм, система, моделирование, корреляция.*

MODEL OF THE MULTISTATE PROCESS IN BIOGAS PLANTS

Abstract*. In this article, a model of multi-state processes taking place in biogas plants is created. When creating a mathematical model of the process taking place in biogas devices, the connection relations between the interdependence elements are mentioned separately. Quantitative level of generalization of each working part of the biogas plant, the exact formula of the level of generalization, which describes the number of parts in the systems, was created, and a number of similar innovations were created.*

Keywords*: process, biogas, model, level, raw material, level of concentration, flow, coefficient, algorithm, system, modeling, correlation.*

KIRISH

Biogaz qurilmalarida kechayotgan anaerab jarayon tizimli bo'lishi [1,2,3,4]bir qurilmaning o'zida kechuvchi jarayonlardagi ko'rsatkichlarni (harorat,aralashtirish,pH, organik chiqindining maydalanganlik darajasi, kundalik yuklash,jarayonning davomiyligi…va boshqalar) matematik modelini tuzish biogaz olishda ko'rilmaganini ko'rsatishi murakkabligini bildiradi[5,6,7]. Bu jarayon matematik modelini tuzish qiyin bo'lmaydigan kichik va aniq tizimlar olinguncha davom ettirish zarur. Boshqa bo'laklanmaydigan bunday kichik tizimlarga murakkab tizimning elementlari deyiladi.

TADQIQOT MATERIALLARI VA METODOLOGIYASI

Yuqorida keltirilgan jarayonni matematik modelini tuzishda o'zaro bog'liqlik elementlar orasidagi bog'lanish munosabatlari muhim rol o'ynaydi, ya'ni haroratni biomassani yuklash tezligiga yoki jarayon davomiyligi nazrda tutiladi.

Murakkab ko'p pog'onali tizimning matematik modeli elementlar tezligiga yoki jarayon davomiyligiga elementlar matematik modellari, tizimli tahlili va ular orasidagi munosabatlar matematik modellaridan iborat.

TADQIQOT NATIJALARI

Qism tizimlarga bo'lishni oddiy qism tizimlar olinganga qadar davom ettiriladi. Ya'ni bu qism tizimlarning matematik ifodalash murakkab bo'lmasligi kerak. Boshqa bo'laklash imkoniyatiga ega bo'lmagan bu qism tizimlarga murakkab tizimning elementlari deyiladi. Bunday elementlarni modellashtirish uchun mo'ljallangan matematik apparatni tanlashda berilgan tizim klassining uni elementlarini va ular orasidagi bog'lanish muhim ahamiyatga ega.

Ko'rinib turibdiki , ko'p holatli texnologik jarayonlar boshqaruvining optimallashtirish matematik modellarini tuzish optimal modellar ishlab turgan boshqaruv tizimlari mavjud bo'lganligi, ko'p pog'onali tizim jarayonlari uzluksiz va diskret bo'lganligi uchun ham murakkabdir.

Bulardan tashqari ko'p holatli tizimning jarayonlari uzluksiz va uzlukli xarakterga ega va bu jarayonlarning ko'pchiligi chiziqli emasligidadir.

Umuman olganda boshqaruv masalalarining xilma-xilligi ko'p pog'onali tizimni tarkiblashni taqazo etadi.Boshqarish tizimli modellarining turli-tumanligi va turli pog'onalarda ularni bir butun deb qarash kerakligi , bunday masalalarni matematik modellashtirish ancha murakkab bo'lganligi uchun ko'p pog'onali tizimni tarkiblashni taqozo etadi. Masalaning optimal modeli tarkibiy qismini tuzish boshqaruvning davriyligidan va modellarning korreksiyalash chastotasiga bog'liq bo'ladi[8,9].

Iyerarxik model shaklida ko'p holatli texnologik jarayonni boshqaruv tizimining barcha holatlari uchun tuzilgan modellarni o'z ichiga oladi deb aytsak bo'ladi.

Bu tizim modelining tarkibi texnologik maydonlarni birlashtirish darajasidan va tizimning har bir qismdagi kichik tizimlariga bog'liq bo'ladi. Biogaz qurilmasining har bir ishchi qismlarini umumlashtirishning miqdoriy darajasi tizimlardagi qism bo'laklari sonini tavsiflaydi. Bunda jamlanish darajasi quyidagicha ifoda bilan aniqlanadi:

$$S = k_s * m^{-1} ,$$

Bu yerda m-intagrallashgan makromodelni qurishda qatnashadigan qism tizimlar soni; k_s– tizimning konstruktiv xosssalarini ifodalaydigan koeffisient.

Biogaz qurilmalarida kechayotgan anaerab jarayon matematik modeli unga kiruvchi alohida lokal qism tizim va konturlar uchun va ular orasidagi bog'lanishlarni ifodalaydigan texnologik jarayonlarni matematik ifodalarini o'z ichiga olgan tenglamalar sistemasidan iboratdir.

Bu tizimning har bir konturi uchun qayta ishlanadigan hom-ashyodan va uning sifatiga bog'liq holda material jihatdan balans qonuni umumiy maxsulot va uning komponentlariga nisbatan bajariladi .Bu sxemani balans hisob-kitobi yordamida kiruvchi xom-ashyo va chiqayotgan maxsulotdan foydalanib aniqlanadi.

Matematik nuqtai-nazardan sxemaning balans hisob-kitobi algebraik tenglamalar sistemasini yechishga keltiriladi. Har bir sxemaning kontur uchun maxsulot massasiga ko'ra quyidagi balans tenglamalarni tuzish mumkin:

$$\sum_{s=1}^{k_{i1}} \gamma_{is}^{bx} = \sum_{s=k_{i2+1}}^{k_{i2}} \gamma_{is}^{вых}, \qquad i = \overline{1,n} \; ; \; s = \overline{1, n_{\iota 1} + n_{\iota 2}}$$

va komponentalar massasiga ko'ra:

$$\sum_{s=1}^{k_{i1}} \gamma_{is}^{bx} d_{ijs}^{bx} = \sum_{s=k_{i2+1}}^{k_{i2}} \gamma_{is}^{вых} d_{ijs}^{вых}, \qquad j = \overline{1,m}\,.$$

Bu yerda i-kontur nomeri, $k -$ konturlar soni, m-komponentalar soni,s- kontur maxsulotning nomeri, $k_{i1}k_{i2}$ - kirishdagi va chiqishdagi maxsulotlar soni.

Shuni ta'kidlash kerakki balans tenglamalari sistemasini yechish bir qator hisoblash qiyinchiliklariga ega : tizim o'lchovlarining kattaligi, yaxshi asoslanmaganligi,noaniqligi rudani boyitish texnologik sxemalarining birgalikda emasligi va yoniqligi. Xom-ashyoni qayta-ishlashning zamonaviy texnologik sxemasi sirkulyatsiya qilinayotgan maxsulotlarning qaytarishsiz amalga oshmaydi, ya'ni quyidagi konturlardan chiqayotgan maxsulot qayta ishlash uchun sxemaning boshiga yuborilishi kerak. Ammo sxema konturini balansini hisoblaganda maxsulotni to'liq xarakteristikasini hisobga olish kerak. Bunda balans tenglamalaridan va ancha murakkab tenglamalardan foydalanishga to'g'ri keladi.

Ikkinchi etapda har bir ajratilgan kontur uchun birinchi etap natijalaridan kelib chiqqan holda torshiriqlar va chegaralanishlarni hisobga olib matematik modellar tuziladi.

Biogaz qurilmalarida kechayotgan anaerab ko'p holatli texnologik jarayonning integrallashgan makromodelini tuzish jarayonini qaraymiz. Biogaz qurilmalarida kechayotgan ko'p holatli texnologik jarayonning u- konturi uchun quyidagi material balans tenglamalari o'rinlidir:

$$\alpha_i \gamma_{\alpha_i} = \beta \gamma_i + \theta_i \gamma_{\theta_i} \, ,$$

$$\gamma_{\alpha_i} = \gamma_{\beta_i} + \gamma_{\theta_i} \, ,$$

Bu yerda $\alpha_i \, , \beta_i \, , \theta_i -$ biogaz qurilmalarida kechayotgan foydali metalning konsentranti va u – konturning chiqindi maxsulotlaridagi foydali metalning miqdori; $\gamma_{\alpha_i} \, \gamma_{\beta_i} \, \gamma_{\theta_i} - u$ – konturning iste'moldagi konsentratdagi va chiqindi maxsulotlaridagi qattiq modda miqdori.

u –chi konturning kirish qismiga boshqa konturlardan va dastlabki oqimdan oqimlar kelishi mumkin. Natijada quyidagilarni olamiz:

$$\alpha_i = \frac{\sum_{j=1}^{\pi} \left(\omega_{ij} \beta_i \gamma_{\beta_i} + \aleph_{ij} \theta_j \gamma_{\theta_j} \right) + \alpha_i^0 \gamma_{\alpha_i}^0}{\sum_{j=1}^{\pi} \left(\omega_{ij} \gamma_{\beta_j} + \aleph_{ij} \gamma_{\theta_j} \right) + \gamma_{\alpha_i}^0}, \qquad (1.5)$$

$$\gamma_{\alpha_i} = \sum_{j=1}^{\pi} \left(\omega_{ij} \gamma_{\beta_i} + \aleph_{ij} \gamma_{\theta_j} \right) + \gamma_{\alpha_i}^0 \qquad (1.6)$$

Bu yerda

$$\omega_{ij} = \begin{cases} I, \text{ agar } j - \text{ konturning konsentrati} \\ \quad i - \text{konturga kelsa,} \\ 0, \text{ qolgan hollarda,} \end{cases}$$

$$\aleph = \begin{cases} I, \quad \text{agar } j - \text{konturning tashlandiq} \\ \quad \text{maxsulotlari} \\ \quad i - \text{konturga kelsa} \\ 0, \quad \text{boshqa holatlarda;} \end{cases}$$

$\alpha_i^0 -$ dastlabki oqimda foydali metalning mavjudligi ;

$\gamma_{\alpha_i}^0 -$ dastlabki oqimda qattiq chiqish.

$i -$ni 1dan n gacha o'zgartirib (1.5), (1.6), tenglamalardan foydalanib chiziqli algebraik tenglamalar sistemasini hosil qilamiz va u sistemasini yechib funksiyalarni topamiz:

$$\gamma_{\beta_i} = \gamma_{\beta_i}(\alpha_1^0, \alpha_2^0 \dots, \alpha_n^0, \gamma_{\alpha_1}^0, \gamma_{\alpha_2}^0, \dots, \gamma_{\alpha_n}^0, \beta_1, \beta_2, \dots, \beta_n, \theta_1, \theta_2, \dots, \theta_n),$$

$$\gamma_{\theta_i} = \gamma_{\theta_i}(\alpha_1^0, \alpha_2^0 \dots, \alpha_n^0, \gamma_{\alpha_1}^0, \gamma_{\alpha_2}^0, \dots, \gamma_{\alpha_n}^0, \beta_1, \beta_2, \dots, \beta_n, \theta_1, \theta_2, \dots, \theta_n),$$

Bunda i ni 1dan n gacha o'zgaradi

i=1,2,..,n .

Agar β_π va γ_{β_π} tayyor maxsulotdagi foydali metal miqdorini anglatsa u holda tenglamalar sistemasi quyidagi texnologik sxema bo'yiha material balans holatidan aniqlanadi:

$$\sum_{i=1}^{\pi} \alpha_i^0 \gamma_{\alpha_i}^0 = \beta_n \gamma_{\beta_n} + \theta_{omb} \gamma_{\theta_{omb}} \ ,$$

$$\sum_{i=1}^{\pi} \gamma_{\alpha_i}^0 = \gamma_{\beta_n} + \gamma_{\theta_{omb}} \ .$$

MUHOKAMA

Bu tizimdan foydali metalning tashlandiq maxsulotlardagi miqdorini aniqlash uchun makromodelni hosil qilamiz :

$$\theta_{omb} = \beta_\pi - \frac{\beta_\pi \sum_{i=1}^{\pi} \gamma_{\alpha_i}^0 - \sum_{i=1}^{\pi} \alpha_i^0 \gamma_{\alpha_i}^0}{\sum_{i=1}^{\pi} \gamma_{\alpha_i}^0 - \gamma_{\beta_n}} .$$

Tayyor konsenteratdagi foydali metal miqdoriga nisbatan makromodel quyidagi ko'rinishga ega:

$$\beta_\pi = \theta_{omb} - \frac{\theta_{omb} \gamma_{\theta_{omb}} - \sum_{i=1}^{\pi} \alpha_i^0 \gamma_{\alpha_i}^0}{\gamma_{\beta_\pi}} .$$

Xuddi shunga o'xshash tayyor konsentratdan foydali metal ajratib olib quyidagicha aniqlanadi:

$$\varepsilon = \beta_\pi \gamma_{\beta_\pi} \Big/ \sum_{i-1}^{\pi} \alpha_i^0 \gamma_{\alpha_i}^0 \ .$$

Shunday qilib modellashtirshning dastlabki etapida faqat konturlarning kirish va chiqish parametrlaridan foydalanib butun jarayon uchun makromodel tuziladi.

Ikkinchi etapda ko'p holatli texnologik jarayonning lokal qism tizimlari uchun makromodel tuziladi.

Tizimning o'rganilayotgan iyerarxik dastlabki global matematik model yordamida ifodalanadi. So'ngra iyerarxiya tarkibidan foydalanib dastlabki makromodeldan lokal qism tizimlarning mikromodellari keltirib chiqariladi. Shunday qilib, masala dastlabki matematik modelning optimal yechimini topishga olib kelinadi. So'ngra har xil metodikalar yordamida olingan natijalar taqqoslanib belgilangan kreteriylarga javob beradigan eng yaxshi metod tanlanadi.

XULOSA

Bunda yuqori darajadagi model quyi darajagi mikromodellarning shartli optimal yechimlarini hisobga olgan holda quriladi. O'z navbatida yuqori darajadagi makromodel yordamida topilgan yechim quyi darajadagi modelga yuboriladi va shu modelda detallashtirilgan yechim qidiriladi.

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