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CONCENTRATIONS FORMULA CONDITIONAL OPTIMALITY WITH RESPECT TO THEIR ENTROPY

The paper theoretically considers the possibility of the multi-optional hybrid functions entropy conditional optimization doctrine applicability with the purpose of discovering substantiated reason for the mean concentration existence, as well as the reasons for the formula optimality. The mean substances concentration in a mixture formula is obtained with taking into account the degree of uncertainty for a certain type hybrid-optional effectiveness functions. The approach has a significance of a plausible explanation for phenomena stipulated by multi-optionality.

Keywords: *mean concentration formula, optimization, entropy doctrine, multi-optionality, hybrid optional function, optimal distribution, variational problem.*

Introduction. Concentrations of substances in mixtures are very important [1-3]. It influences the reliability and maintainability of engineering devices [4]. It refers to aircraft maintenance and repair technologies [5, 6] or power losses in gear systems [7].

Mathematically, it is the simplest problem; it expresses just the ratio of masses:

$$c_i = \frac{G_i}{G}, \qquad G = \sum_{i=1}^{n} G_i, \qquad \sum_{i=1}^{n} c_i = 1, \tag{1}$$

where c_i is the mass fraction (mean concentration) of each component, G_i is the mass of the given component, G is the total mass of the mixture. Equations (1) can be found, perhaps, at any books on both chemistry and physics [2].

State of the problem. Although equations (1) are absolutely simple and exactly correct, there is always a necessity to make known some new aspects of the objectively existing phenomena with certain plausible scientific explanations [8, 9].

This definitely continues to instigate the scientifically grounded research in the fields of knowledge discovering [10-16]. In this respect, the identified research gap is still the lack of the newly emerged theories [10-31] connections to the well-known concepts, likewise equations (1) [2], having already been used through the centuries.

Problem setting. According to the state of the problem, it is required to find the equations (1) following a certain variational principle of multi-optional conditional optimality of special hybrid-optional effectiveness functions uncertainty [15].

Purpose of the paper. The presented paper is aimed at discovering the substantiated reasons for a substances mixtures mean concentrations formula (1) optimality existence and to demonstrate, on such an example, the multi-optional hybrid functions entropy conditional optimization principle, as a doctrine [10-31], applicability.

Multi-optional concept. The masses of the given components contained in a mixture can be considered as the options of the mixture formation process. Now, the options being treated in the framework of the multi-optional hybrid functions entropy conditional optimization doctrine will make it possible constructing an objective functional of the following kind:

$$\Phi_c = -\sum_{i=1}^{n} c_i \ln c_i + \beta \sum_{i=1}^{n} c_i \ln G_i + \gamma \left[\sum_{i=1}^{n} c_i - 1 \right], \tag{2}$$

where β is some indispensible, undetermined yet parameter of the process, γ is the other intrinsic parameter for the constrain of the normalizing condition: $\sum_{i=1}^{n} c_i - 1 \equiv 0$, β and γ are the internal structural parameters of the hybrid optional functions c_i distribution (conditional optimal distribution of the concentrations functions with respect to the functions' degree of uncertainty and regarding to the supposed possible logarithmic values $\ln G_i$ of the corresponding optional effectiveness functions).

The necessary conditions of functional (2) extremum existence yield

$$\frac{\partial \Phi_c}{\partial c_i} = -\ln c_i - 1 + \beta \ln G_i + \gamma = 0, \qquad \forall i \in \overline{1,n}. \tag{3}$$

Then from conditions (3)

$$\ln c_i = \gamma - 1 + \beta \ln G_i, \qquad c_i = e^{\gamma - 1 + \beta \ln G_i} = e^{\gamma - 1} e^{\beta \ln G_i} = e^{\gamma - 1} G_i^{\beta}. \tag{4}$$

The normalizing condition of functional (2) inevitably means

$$\sum_{j=1}^{n} c_j = 1 = e^{\gamma - 1} \sum_{j=1}^{n} G_j^{\beta}, \qquad e^{\gamma - 1} = \frac{1}{\sum_{j=1}^{n} G_j^{\beta}}, \qquad c_i = \frac{G_i^{\beta}}{\sum_{j=1}^{n} G_j^{\beta}}. \tag{5}$$

The obtained result of (5) at the value of

$$\beta = 1 \tag{6}$$

is identically nothing else as the mass fraction of (1).

Discussion on the proposed doctrine. The proposed doctrine (2-6) is different from the entirely logical for the mean concentration c_i determination approach (1). Parameter β conceptually takes into account uneven local distributions of substances.

The traditional view entropy figuring out in the objective functional expression (2) is incapable to catch the positive, negative, or neutral properties of the uncertainty of the mixtures substances distributions, whereas the developed in reference [25] hybrid combined relative pseudo entropy function:

$$\overline{H}_{\max \frac{\Delta c}{|\Delta c|}} = \frac{H_{\max} - H_c}{H_{\max}} \cdot \frac{\Delta c}{|\Delta c|} \tag{7}$$

can really make help with such problem of the concentrations uncertainty direction determination.

Here in expression (7) $H_{\max}$ is the maximal possible entropy (uncertainty) of concentrations, H_c is the factual entropy,

$$\Delta c = \sum_{j=1}^{M} c_j^{+} - \sum_{k=1}^{L} c_k^{-}, \tag{8}$$

where c_j^{+} and c_k^{-} are positive and negative properties concentrations respectively, M and L are numbers of the substances with the positive and negative properties:

$$M + L = n. \tag{9}$$

Conclusions. It is discovered an explanation for the mass fraction formula (1) in terms of the multi-optional conditional optimality doctrine for the special hybrid-optional effectiveness functions uncertainty (2-6). Parameters of the hybrid combined relative pseudo entropy function (7-9) need further investigation.

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УМОВНА ОПТИМАЛЬНІСТЬ ФОРМУЛИ КОНЦЕНТРАЦІЙ ЩОДО ЇХНЬОЇ ЕНТРОПІЇ

Стаття розглядає теоретично можливість застосування доктрини умовної оптимізації ентропії багатоопційних гібридних функцій з метою відкриття обґрунтованої причини існування середньої концентрації, а також причин оптимальності тієї формули. Формула середньої концентрації речовини у суміші отримується з урахуванням ступеня невизначеності певного типу гібридно-опційних функцій ефективності. Даний підхід має значущість правдоподібного пояснення для явищ, обумовлених багатоопційністю.

Ключові слова: формула середньої концентрації, оптимізація, ентропійна доктрина, багатоопційність, гібридна опційна функція, оптимальний розподіл, варіаційна задача.

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