Complex Entropy-Informational Criteria: In Ferrous Metallurgy

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Abstract

The author has developed an information assessment of technological schemes of producing steel by refining cast iron and by the method of direct production. There are presented methods of entropy-information analysis of technological stages according to the dynamics of increasing the content of Iron from raw materials to the final product, as well as entropy-information analysis of technological stages of producing ferrous metals depending on the method of smelting. The novelty of the research topic lies in the fact that for the first time objective and fundamental information criteria expressed in universal units of information, bits, were applied to analyzing the technology of chemical and metallurgical processes and schemes for producing ferrous metals.

In general characterization of the entropy-information analysis of any objects, there is widely used the Shannon statistical formula to express the uncertainty of any system:

$$H = -\sum_{i=1}^{N} p_i \log_2 p_i$$

where *pi* is the probability of detecting some uniform element of the system in their set *N*.

Let's consider the use of this formula to quantify the uncertainty of the quality of a product or technological process through the uncertainty of the main element of the system. As the probability of detecting the main element of the technological system, one can take its content in the product, expressed in fractions of a unit. For example, this is the content of the extracted chemical element in the products of the technological stage.

Thus, the complex certainty of the technological scheme of steel production is expressed through the product of the fractional content and extraction of iron at each level of the scheme. The results of comparative calculations for stages and in general for the technological scheme of steel production are presented in Table 1,2. We will illustrate the verification of calculated indicators graphically in accordance with Figure 1 (a,b). We have established a closer correlation with the differentiated model of an ideal hierarchical system, which indicates the most fundamental study of each conversion of steel direct production. In order to improve steelmaking production, specialists from many of the world's leading metallurgical companies continue to develop environmentally friendly and cheaper steelmaking technologies.

Table 1. Information characteristics of the iron content and recovery indicators in the technological flowsheet of steel production by iron refining

Technological conversions	Content indicators α		Recovery indicators β		$H_{\alpha\beta}$	$p_{\alpha\beta}$
	α	H_α,bit	β	H_β,bit		
Mining	0.5000	1.0000	0.1020	3.2934	4.2934	0.0510
Dressing	0.6550	0.6104	0.8700	0.2009	0.8113	0.5696
Metallization	0.8830	0.1795	0.9910	0.0130	0.1925	0.8751
Cupola smelting	0.9550	0.0664	0.9980	0.0029	0.0693	0.9531
Resmelting	0.9950	0.0072	0.9990	0.0014	0.0086	0.9940
Refining	0.9999	0.0001	0.9999	0.0001	0.0002	0.9998
H_k, bit	-	1.8636	-	3.5117	5.3753	-
p_k, u.f.	0.2748	-	0.0877	-	-	$2.4087 \cdot 10^{-2}$