

FUNCTIONAL FEATURES OF SEMANTIC PHENOMENA IN THE METALLURGICAL TERMINOLOGY OF ENGLISH AND UZBEK

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Abstract. This article comparatively examines the functional and semantic features of synonymy, polysemy, antonymy, metaphorical and metonymic transfer, semantic specialization, semantic extension and narrowing, and borrowing in the metallurgical terminology of English and Uzbek. The study aims to identify similarities and differences between the two terminological systems on the basis of the relationships among form, concept, semantic relations, and contextual realization. Descriptive, comparative-typological, semantic, componential, functional-semantic, and terminographic approaches are employed. The analysis is grounded in the object-concept-definition-designation relations established in ISO 704:2022. The findings indicate that synonymy is associated with alternative designations of the same or closely related concepts; polysemy involves several semantically related meanings expressed by one lexical form; and terminological specialization results from the acquisition of a domain-specific meaning by a general-language unit. The comparison also demonstrates that semantic asymmetry between English and Uzbek metallurgical terminology is related to borrowing, calquing, derivation, contextual specialization, and differences in terminological structure. Examples such as casting, charge, melt, ore, slag, grain, furnace, and their Uzbek equivalents illustrate the role of context in establishing terminological meaning. The results may contribute to terminology studies, technical translation, terminography, and professional communication in the metallurgical field.

Keywords: metallurgical terminology, term, synonymy, polysemy, antonymy, semantic specialization, metaphor, metonymy, semantic asymmetry, terminological equivalence, context, concept, English, Uzbek.

INGLIZ VA O'ZBEK TILLARI METALLURGIYA TERMINOLOGIYASIDAGI SEMANTIK HODISALARNING FUNKSIONAL XUSUSIYATLARI

Annotatsiya. Ushbu maqolada ingliz va o'zbek tillari metallurgiya terminologiyasidagi sinonimiya, polisemiya, antonimiya, metaforik va metonimik ko'chirish, semantik ixtisoslashuv, semantik kengayish va torayish hamda o'zlashmalarning funksional va semantik xususiyatlari qiyosiy jihatdan tadqiq etiladi. Tadqiqotning maqsadi shakl, tushuncha, semantik munosabatlar va kontekstual realizatsiya o'rtasidagi bog'liqlik asosida ikki terminologik tizim o'rtasidagi o'xshashlik va farqlarni aniqlashdan iborat. Ishda tasviriy, qiyosiy-tipologik, semantik, komponentlik, funksional-semantik va terminografik yondashuvlardan foydalanilgan. Tahlil ISO 704:2022 standartida belgilangan «ob'ekt-tushuncha-ta'rif-belgilash» munosabatlariga asoslanadi. Natijalar shuni ko'rsatadiki, sinonimiya bir xil yoki yaqin tushunchalarning muqobil belgilanishi bilan bog'liq; polisemiya bitta leksik shakl orqali ifodalangan bir nechta semantik aloqador ma'nolarni o'z ichiga oladi; terminologik ixtisoslashuv esa umumiste'moldagi birlikning sohasiy ma'no kasb etishi natijasida yuzaga keladi. Shuningdek, qiyosiy tahlil ingliz va o'zbek tillari metallurgiya terminologiyasi o'rtasidagi semantik asimmetriya o'zlashmalar, kalkalash, so'z yasalishi, kontekstual ixtisoslashuv va terminologik strukturadagi farqlar bilan bog'liqligini ko'rsatadi. Casting, charge, melt, ore, slag, grain, furnace kabi misollar va ularning o'zbekcha ekvivalentlari terminologik ma'noni belgilashda kontekstning o'rnini yoritib beradi. Tadqiqot natijalari terminshunoslik, texnik tarjima, terminografiya hamda metallurgiya sohasidagi kasbiy muloqotni rivojlantirishga hissa qo'shishi mumkin.

Kalit so'zlar: metallurgiya terminologiyasi, termin, sinonimiya, polisemiya, antonimiya, semantik ixtisoslashuv, metafora, metonimiya, semantik asimmetriya, terminologik ekvivalentlik, kontekst, tushuncha, ingliz tili, o'zbek tili.

ФУНКЦИОНАЛЬНЫЕ ОСОБЕННОСТИ СЕМАНТИЧЕСКИХ ЯВЛЕНИЙ В МЕТАЛЛУРГИЧЕСКОЙ ТЕРМИНОЛОГИИ АНГЛИЙСКОГО И УЗБЕКСКОГО ЯЗЫКОВ

Аннотация. В данной статье сравнительно анализируются функциональные и семантические особенности синонимии, полисемии, антонимии, метафорического и переноса по смежности (метонимии), семантической специализации, расширения и сужения значения, а также заимствований в металлургической терминологии английского и узбекского языков. Цель исследования — выявление сходств и

различий между двумя терминологическими системами на основе взаимосвязи между формой, понятием, семантическими отношениями и контекстуальной реализацией. В работе используются описательный, сравнительно-типологический, семантический, компонентный, функционально-семантический и терминографический подходы. Анализ опирается на отношения «объект–понятие–определение–обозначение», установленные в стандарте ISO 704:2022. Результаты показывают, что синонимия связана с альтернативными обозначениями одного и того же или близких понятий; полисемия включает несколько семантически связанных значений, выраженных одной лексической формой; а терминологическая специализация является результатом приобретения общеупотребительной единицей узкоспециального значения. Сравнение также демонстрирует, что семантическая асимметрия между английской и узбекской металлургической терминологией обусловлена заимствованием, калькированием, словообразованием, контекстуальной специализацией и различиями в терминологической структуре. Такие примеры, как *casting, charge, melt, ore, slag, grain, furnace* и их узбекские эквиваленты, иллюстрируют роль контекста в установлении терминологического значения. Результаты исследования могут внести вклад в терминоведение, технический перевод, терминографию и профессиональную коммуникацию в области металлургии.

Ключевые слова: металлургическая терминология, термин, синонимия, полисемия, антонимия, семантическая специализация, метафора, метонимия, семантическая асимметрия, терминологическая эквивалентность, контекст, понятие, английский язык, узбекский язык.

Introduction. Metallurgy is one of the oldest and strategically important areas of human production. Knowledge and practical experience associated with the extraction, processing, melting, refining, alloying, and technological use of metals have developed over long historical periods. Today, metallurgy constitutes an important industrial sector and provides a technological basis for mechanical engineering, energy, construction, transport, defense, electronics, and other fields. Alongside the development of the industry, a specialized terminological system has emerged to designate metallurgical concepts precisely and economically. For this reason, the linguistic study of metallurgical terminology represents an important area of contemporary terminology, lexicology, semasiology, and comparative linguistics.

A terminological system reflects the conceptual structure of a scientific or industrial domain. Metallurgical terms designate the physical and chemical properties of metals, production technologies, raw materials, the composition of metals and alloys, melting and processing operations, equipment, technological procedures, and finished products. The formation and development of such terminology are influenced not only by general lexical processes but also by technological progress, international scientific communication, economic relations, and accumulated industrial experience. Consequently, semantic specialization, terminologization, determinologization, synonymy, polysemy, antonymy, metaphor, metonymy, and semantic extension and narrowing can be observed in metallurgical terminology.

A comparative study of English and Uzbek metallurgical terminology is particularly relevant because English functions as a major language of international scientific and technical communication, while Uzbek terminology develops through the internal resources of the national language as well as through borrowing and international terminology. Comparing semantic processes in the two languages makes it possible to identify both common tendencies and language-specific patterns in the semantic structure and functional behavior of terms.

An important issue is the relationship between terms and general vocabulary. A lexical unit may have a broad meaning in general language but acquire a precise, domain-specific meaning in metallurgy. Examples include *casting, refining, rolling, forging, and smelting* in English and *quyish, tozalash, prokatlash, bolg'lash, and eritish* in Uzbek. Their meanings in metallurgical discourse are determined by professional and technological context.

Terminologization is therefore central to the development of metallurgical vocabulary. General-language units may enter a specialized system and acquire a scientific or technical meaning. For example, *grain* may denote a grain in general language but a crystalline grain in materials science and metallurgy; *matrix* may denote a matrix in general scientific usage but a principal phase containing other phases in materials science. Similar specialization can be observed in Uzbek technical vocabulary.

The practical relevance of the issue is reinforced by the globalization of metallurgical production and the increasing exchange of scientific and technical information. Accurate semantic interpretation is essential when translating scientific literature, standards, technical instructions, textbooks, and production documentation. An inappropriate translation of a polysemous term outside its context may distort the meaning of a technological process. Accordingly, the functional-semantic analysis of English and Uzbek metallurgical terminology is relevant not only to theoretical linguistics but also to technical translation, terminology management, education, and professional communication.

The aim of this study is to identify semantic phenomena occurring in English and Uzbek metallurgical terminology, compare their functional features, and determine common and language-specific characteristics of the two terminological systems. To achieve this aim, the study examines terminologization and determinologization, polysemy, synonymy, antonymy, semantic extension and narrowing, metaphorical and metonymic transfer, semantic adaptation of borrowed terms, and the functional role of terms in scientific and technical communication.

Literature Review. Terminology research emphasizes the role of terms as linguistic designations of specialized concepts. Cabré's work treats terminology as a field connected with cognition, language, and communication, while ISO 704:2022 provides principles for terminology work and emphasizes the relationship among objects, concepts, definitions, and designations [1–4]. These approaches are useful for analyzing metallurgical terms not merely as isolated lexical units but as elements of a structured conceptual system.

In actual technical communication, however, complete one-to-one correspondence between a term and a concept is not always observed. Rapid technological development may expand the semantic range of an established term, while general-language words may acquire specialized meanings. This makes polysemy and semantic specialization relevant to metallurgical terminology.

Polysemy involves several related meanings associated with one lexical form. In metallurgy, the interpretation of a term may depend on the technological stage, material, operation, or process in which it occurs. For example, casting may refer to a casting process, a casting technology, or, in certain contexts, a cast product. The Uzbek term *quyish* similarly requires contextual interpretation.

Metaphorical transfer is another productive mechanism. Technical terms may arise from similarities in shape, structure, movement, or function. English units such as head, neck, skin, grain, seed, flow, and casting can acquire specialized meanings in metallurgical contexts. Uzbek technical vocabulary likewise contains units such as *bosh*, *bo'yin*, *don*, *oqim*, *o'zak*, and *qobiq*. In scientific terminology, such metaphors primarily serve economical and recognizable designation rather than artistic expressiveness.

Metonymic transfer is based on conceptual proximity, for example between a process and its result, a material and a product, or equipment and the operation performed with it. Such relations can be observed in metallurgical terminology in both languages and contribute to terminological economy.

Synonymy and terminological variation also occur in real scientific and industrial discourse. International terms may coexist with native or translated variants. In Uzbek, borrowed terms may be used in parallel with calqued, descriptive, or nationally adapted forms. This enriches terminology but may also create challenges for standardization.

Antonymy and hierarchical relations are also structurally significant. Pairs such as heating-cooling, melting-solidification, and hardening-softening distinguish technologically opposed processes. Hyperonymic and hyponymic relations organize concepts such as metal, alloy, ore, mineral, furnace, and specific members of these classes. Borrowing, calquing, and terminologization further demonstrate the interaction between language development and technological change.

Methodology. The methodological basis of the study is a systematic, comparative, and functional-semantic analysis of English and Uzbek metallurgical terminology. Metallurgy is treated as a specialized terminological domain, and terms are examined with regard to their form, semantic structure, conceptual relations, and functions in professional communication.

The comparative-typological method is used to identify similarities and differences between English terms and their Uzbek counterparts. The analysis considers structural form, semantic content, nominative function, semantic scope, and domain of use. Particular attention is paid to cases in which corresponding terms designate the same technological concept but differ in semantic scope or contextual distribution.

Semantic analysis is employed to identify monosemy, polysemy, synonymy, antonymy, metaphorical and metonymic transfer, and semantic specialization. Functional-semantic analysis is used to determine how terms operate in scientific texts, technical documentation, educational materials, and descriptions of technological processes. Componential analysis is applied to identify shared and language-specific semantic features in corresponding term pairs. The study also takes terminographic principles into account when considering terminological designation and equivalence.

Results and Discussion. The analysis shows that semantic phenomena play a significant role in the formation, development, and practical use of English and Uzbek metallurgical terminology. Because metallurgy interacts with chemistry, physics, geology, mechanical engineering, and energy, its terminology is continuously enriched. This enrichment occurs not only through the creation of new lexical units but also through semantic extension, narrowing, transfer, specialization, borrowing, and contextual reinterpretation.

The comparison indicates that the two languages share major semantic mechanisms, although their realization differs because of structural characteristics, historical development, and language contact. English metallurgical terminology is strongly associated with international scientific and technical vocabulary and compact multiword formations. Uzbek terminology combines internal word-formation resources with borrowing, calquing, descriptive translation, and adaptation of international terms.

Semantic Specialization of Terms. A major finding is that general-language units may acquire specialized metallurgical meanings. English examples include ore, slag, charge, melt, casting, scale, and flux. For instance, charge may denote a load or the act of charging in general English, whereas in metallurgy it denotes the material or group of materials charged into a furnace or other processing unit. Melt may function as a verb in general language but as a technical noun referring to molten material or the molten state in metallurgical discourse.

Uzbek also demonstrates specialization through units such as *eritma*, *eritish*, *quyish*, *shlak*, *shixta*, *ruda*, *qotishma*, *pech*, and *o'zak*. In technical contexts, these units acquire a more restricted and standardized meaning. The principal function of semantic specialization is terminological precision: context transforms a potentially broad lexical unit into a designation of a specific professional concept.

Functional Features of Polysemy. Polysemy is observed particularly in terms denoting processes, products, technological operations, and physical states. The English term casting, for example, may refer to the casting process, casting technology, or a cast product depending on context. Rolling may designate the rolling process and, in particular contexts, concepts associated with rolled products. In Uzbek, *quyish*, *prokatlash*, *eritish*, *qizdirish*, and *qotish* likewise acquire their precise interpretation from syntactic and technological context.

The functional value of polysemy lies partly in terminological economy. The development of an established term can provide a designation for a related concept without creating an entirely new lexical item. At the same time, contextual precision becomes essential for avoiding ambiguity in technical communication.

Metaphorical Semantics. Metaphorical transfer is a productive means of naming technological and structural features. English units such as skin, neck, head, tail, finger, and arm may denote specific parts or features of metallurgical objects on the basis of similarity in shape, position, or function. For example, skin may refer to the external layer or surface of a metallic object. Uzbek equivalents and related formations include qobiq, bo'yin, bosh, o'zak, and similar terms used in technical combinations.

The principal function of metaphorical terminology is to provide concise and cognitively accessible designations for complex physical or technological phenomena. Unlike literary metaphor, technical metaphor is primarily constrained by conceptual and communicative requirements. **Metonymy and Functional Meaning Transfer.** Metonymic transfer is based on contiguity between a process, material, equipment, product, or result. A process name may be used in connection with its result, while an equipment term may denote the technological system or operation associated with it. Uzbek units such as quyma, eritma, qotishma, and prokat illustrate semantic relations among process, product, and material. Such relations support economy and reduce the need to create independent lexical designations for closely connected concepts. **Synonymy and Terminological Variation.** The comparison confirms the presence of synonymous and variant designations in both languages. English may contain international and local terms, abbreviations, and structural variants. Uzbek may use borrowed terms alongside translated or descriptive equivalents. Such variation can facilitate the development of terminology, but it may also complicate standardization. Consequently, terminological selection should take into account conceptual precision, brevity, transparency, and acceptance by specialists.

Semantic Adaptation of Borrowed Terms. Borrowing is especially important in an internationally oriented field such as metallurgy. Uzbek metallurgical vocabulary contains terms such as metall, material, prokat, domna, konverter, elektrod, alyuminiy, nikel, xrom, marten, and shlak that have entered the language through international or intermediary terminology. During integration into Uzbek, borrowed terms may undergo phonetic, morphological, and semantic adaptation. They can also serve as bases for new derivatives, as in metallurgik and prokatlash. Thus, borrowing contributes not only to the adoption of established terms but also to further terminological formation.

Structural-Semantic Features and Cross-Linguistic Differences. The data indicate that multiword terms constitute an important part of metallurgical terminology. English examples include blast furnace, electric arc furnace, stainless steel, carbon steel, hot rolling, cold rolling, continuous casting, and heat treatment. Their Uzbek counterparts include domna pechi, elektr yoyli pech, zanglamaydigan po'lat, uglerodli po'lat, issiq prokatlash, sovuq prokatlash, uzluksiz quyish, and issiqlik bilan ishlov berish. Semantic equivalence therefore does not necessarily entail structural equivalence.

English frequently employs compact attributive combinations, whereas Uzbek often expresses the same concepts through modifier-head constructions, affixation, or descriptive combinations. For example, steelmaking corresponds to po'lat ishlab chiqarish, metalworking to metallga ishlov berish, and heat treatment to issiqlik bilan ishlov berish. These differences are consistent with the grammatical and typological characteristics of the two languages.

Practical Significance for Translation, Education, and Professional Communication. Semantic analysis of metallurgical terminology has practical value for technical translation, education, and professional communication. Scientific articles, standards, manuals, textbooks, and production instructions require accurate interpretation of terms in context. Literal translation of polysemous or metaphorically motivated terms may produce semantic errors. For this reason, contextual and domain-specific meaning should take precedence over an isolated dictionary meaning when a metallurgical term is translated.

The findings are also relevant to teaching English for metallurgical purposes. Learners should not merely memorize equivalents but should understand how a term changes its interpretation across technological contexts. This approach can improve the reading of technical texts and participation in international scientific and professional communication.

Comparative Summary of Major Semantic Phenomena

Phenomenon	English example	Uzbek equivalent	Semantic relation	Functional role
Synonymy	iron – ferrum	temir – ferrum	Alternative designations of one concept	Links national and international terminology
Antonymy	heating – cooling	qizdirish – sovitish	Opposed technological processes	Distinguishes process stages
Polysemy	casting	quyish	Related meanings determined by context	Supports terminological economy
Metaphor	steel grain	po'lat donasi	Transferred meaning based on similarity	Concise designation of microstructure
Metonymy	furnace	pech / production unit	Contiguity of equipment and process/system	Economical reference to production objects
Specialization	slag	shlak	General meaning → specialized domain meaning	Provides technical precision
Terminological narrowing	billet	zagotovka	General concept → specific production stage	Identifies a particular technological stage

Conclusion. The study demonstrates that English and Uzbek metallurgical terminology constitutes a dynamic semantic system in which polysemy, semantic specialization, metaphor, metonymy, synonymy, borrowing, and semantic extension and narrowing interact. These processes contribute to the formation, development, and functional organization of metallurgical vocabulary.

The differences between the two terminological systems are determined not only by the external form of terms but also by semantic structure, contextual distribution, functional load, and patterns of standardization. English demonstrates a strong tendency toward international terminology and compact term formation, whereas Uzbek combines borrowed units with national adaptation, calquing, descriptive translation, and affixal derivation.

The comparative study of metallurgical terms can therefore provide a basis for improving terminological equivalence, technical translation, terminology standardization, and professional communication. A deeper analysis of semantic phenomena also supports more accurate transfer of metallurgical knowledge between English and Uzbek. The results are relevant to terminology, comparative linguistics, technical translation, professional education, and international scientific and technical communication.

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