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FEATURE

Specificities and origins of the Slovak nomenclature of inorganic chemistry

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Abstract Nowadays the discussion on the symbiosis of the international and national nomenclature systems in different areas of science provides clear evidences that full implementation of conventional international (mainly English) nomenclature principles in the local ones is sometimes not only unnecessary, but even redundant or impossible. Rapid development of natural sciences necessitates creation of accurate, comprehensive and comprehensible nomenclature systems for objects and phenomena under research. This study outlines the origins and development of the Slovak chemical nomenclature which is based on the Czech model. We analyze the unique Slovak nomenclature items as well as the re-evaluation of linguistic means in the field of inorganic chemistry in the international context. A part of this work is devoted to the syntactical structure of the names of inorganic compounds. At the same time we draw a parallel between chemical nomenclature and the phenomenon of controlled language.

Keywords Nomenclature · Terminology · Inorganic chemistry · Controlled language · Terminology management

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Introduction

Scientific domains exploit and shape the language and its resources according to their needs and in specific cases they tend to eliminate or reduce its dynamic and polysemous character. It is more than natural that this "modification" of linguistic means is in direct proportion to the requirements of accuracy or consistency in respective disciplines. Chemistry is no exception, on the contrary. Nomenclature of chemical substances provide clearly defined rules that are to be used when writing chemical formulas and coining names, which assures their accuracy, consistency, general usage, international intelligibility and explicitness. Basic "building blocks" of chemical nomenclature include chemical symbols, formulas, names of elements and their compounds. The document "Brief Guide to the Nomenclature of Inorganic Chemistry" provides an outline of the essential nomenclature rules for producing names and formulae for inorganic compounds, coordination compounds, and organometallic compounds (Hartshorn et al. 2015). Further details can be found in the Nomenclature of Inorganic Chemistry, colloquially known as the Red Book (Connelly et al. 2005).

As the chemical nomenclature and chemistry themselves are not static, but undergo continual changes and development, gathering, description, analysis, and preservation of relevant knowledge and information on chemical entities and their composition can be provided only by means of terminology and information management at national as well as international levels. It is the IUPAC (International

Union of Pure and Applied Chemistry), IUBMB (International Union of Biochemistry and Molecular Biology) and other international organisations that guarantee the restriction of "arbitrary proliferation of substance names" (Wright and Budin 2001, p. 229).

Terminology and nomenclature

Terminology represents an organised set of linguistic means of a specific field, which usually includes designations of phenomena, processes or tools, e.g. *molecule, reduction, bond* or *gas* (ISO 51271-1). The meanings, or concepts these designations refer to, were defined or are generally acceptable and understandable. Nomenclature, however, is a set of names designating chemical entities and according to the norm ISO 1087-1 it is a specific kind of terminology, which is "structured systematically according to pre-established naming rules", e.g. *carbon dioxide, sodium chloride, hydrochloric acid.*

The above-mentioned definition of terminology or the definition originating from the Slovak linguistic tradition[1] shows that the specificity of terms, in comparison with nomenclature items, lies in their defining by the respective domain experts. However, nomenclature items are definition-free (and this fact does not hold true only for chemistry but also for botany and zoology). Individual chemical names as designations of abstract ideas of the character of chemical entities do not require definitions. This is due to the linguistic structure of the systematic names as such for they reflect not only the type of the chemical entity but they also indicate its characteristics or the class it belongs to. It could be claimed that these designations, by some authors referred also as *nómen* (Majtán 1979), can be situated somewhere in midway between common nouns and proper names—similarly to proper names they are not usually employed in plural (conf. **sulfuric acids*), on the other hand they do not serve for singling out specific realities and phenomena (as it is the case e.g. with the name of the international organisation IUPAC).

Controlled vocabulary

When discussing the linguistic specificities of the chemical nomenclature it is worthwhile to consider the issue of the so-called controlled language or controlled vocabulary (referred to also under various other terms: *controlled language, controlled natural language, processable language, simplified language, technical language, structured language*, etc.). In general, this phenomenon is defined as a set of consistent terms used within a specific area of human knowledge (Richard et al. 2003, pp. 157–167). Originally, the need to establish such an inventory of lexical items arose in the field of library science. Its creation aimed at precise labelling of documents and their further retrieval and this was managed by artificial corrections of natural language items. Nowadays, the term "controlled language" occurs predominantly in connection with catalogues and databases, i.e. products with primary aim to organise and classify the information. However, it is also employed in the aviation industry (both in aircraft production and navigation), or at the latest in the framework of information technologies.

The ambition of the controlled vocabulary is to regulate its items so that they would have unique relationship with their respective concepts, e.g. each item would denote only one concept and vice versa, every concept would be named only by one linguistic form. However, this is an unattainable ideal, designated by the founder of terminological theory E. Wüster by the German term *Eineindeutigkeit*. In practical terms, this means that the lexicon should lack homonyms (words with different meaning but identical form), synonyms (words with similar or related meaning) or polysemy (words which include several meanings in one form). Moreover, such a vocabulary comprises rules, procedures and methodologies which assure clarification of semantic relationships between individual elements (http://www.newworldencyclopedia.org/entry/Controlled_vocabulary).

Institutional regulation and harmonisation of chemical nomenclature bear similarities with the controlled vocabulary, for some authors consider it the artificial language (Kahovec 2000), which consists of items that can unambiguously name several millions of chemical compounds. It was chemistry which saw a kind of revolution in intentional regulation of linguistic means in the professional communication—for the first time in history the scientists, namely French chemists inspired by Condillac's philosophy of language, attempted to introduce naming rules. In cooperation with other scientists they coined not only new words but also systematic endings with precisely defined meaning (Cottez 1994). Their attempt was successful and many of their newly coined words have been in use since then also thank to the fact that they in turn originated new designations. This process was soon imitated in other natural sciences.

One of the specificities of the chemistry as a discipline lies in the symbiosis of graphical and linguistic representation of chemical substances; graphic forms—chemical formulas—can be derived from the linguistic structures. It may be also said that formulae mirror the word-forming

[1] "Term is an element of the lexicon designating a concept determined by a definition and its place in a conceptual system of a specific scientific, technical, economical and other disciplines" (Masár 1991, p. 29).

structure of chemical designations, which is a parallel to the linguistic reflection of the chemical structure of chemical entities.

Therefore, it is reasonable to analyse the way how the chemical nomenclature makes use of the classificatory and systematic potential of the language and also the way it re-evaluates and re-uses the resources of the standard Slovak language in the field of inorganic chemistry.

In general, the names of chemical entities consist of the names of elements and affixes, i.e. prefixes, suffixes or infixes with clearly delimited and defined content. Sometimes, to narrow or specify the meaning, numerical signs (not only numerical prefixes) are used, as well as letters of Greek alphabet, punctuation (e.g. hyphen, dash) and even the order of constitutive parts of the name.[2] Some affixes, however, are polysemous, but this fact does not represent a risk of misunderstanding because individual meanings of these affixes are context-dependent, e.g. the suffix *-án* is used to coin names of inorganic binary compounds with metalloids and non-metals, while in organic chemistry it is employed to name hydrocarbons.

Beginnings of Slovak and Czech chemical nomenclature

Origins of the Slovak chemical nomenclature are dated to the 19th century's early Czech scientific writings, for the standardisation of Slovak language in 1843 came later in comparison with Czech language. The first descriptions and analyses of specialised lexicon (e.g. by scholars M. Godra or I. B. Zoch) were primarily oriented towards those disciplines whose lexicon was based on the folk language, which excluded chemistry.[3] The borrowing and adaptation of chemical terminology and nomenclature from Czech, or its slovakisation, was enhanced especially by socio-political changes—the establishment of the Czechoslovak Republic in 1918 and consequent introduction of Slovak language into schools including the education of chemistry in Slovak, which required "rewriting" of Czech textbooks into Slovak.

The Czech pioneers of the specialised chemical literature are considered to be Josef Jungmann, Vojtěch Šafařík and especially Jan Svatopluk Presl (1791–1849) who tried to imitate the efforts of French chemists and introduced Czech names for all chemical elements known in that period of time. Presl derived them both from the words of general lexicon and Latin word-stock and combined them with his newly coined systematic suffix *-ík*. To this day both languages, Czech and Slovak, use ten of his original names for elements *oxygen*, *carbon, hydrogen, nitrogen, aluminium, calcium, magnesium, potassium, silicon, sodium* (kyslík, uhlík, vodík, dusík, hliník, vápnik, horčík, draslík, kremík, sodík). Only a minimal number of names for chemical elements were taken over from general Czech and Slovak without any change: *iron, mercury, copper, gold, silver, lead* (železo, ortut', med', zlato, striebro, olovo).

Most of current names of chemical elements have their origin in foreign languages, especially Greek and Latin. Etymological analyses and history proves that these names were formed on the basis of inherent features of respective elements such as their quality, colour or extrinsic characteristics (i.e. function, place of production, occurrence, and inventor). However, in case of discovering new elements (with atomic number over 100) their designations are nowadays coined by means of agglutination, i.e. simple joining of numeral morphemes of Greek and Latin origin reflecting the atomic number of the respective element, the last part of the name being the Latin suffix *-ium*. Also this combination of two Classical languages, hybrid in terms of etymology (numeral morpheme *nil, un, bi, quad, sep, okt* are Latin, while *tri, pent, hex* and *enn/en* are Greek), eloquently shows that current word-formation tendency follows only purely pragmatic view of function. Moreover, usage of the elements from the word-stock of Classical languages serves two aims—on one hand it guarantees the stability of the nomenclature and on the other hand it enhances its international character. As noted J. Horecký, prominent Slovak linguist and terminologist, "internationalisation is more understandable and prospective especially in this nomenclature than in any other. However, the by-product is often the loss of binary word-formatting structure and enhancement of the linear morphemic structure" (Horecký 1993).

The impact of internationalisation in the Slovak chemical nomenclature can be seen also in the existence of parallel designations of domestic and Classical origin. For example, for naming some compounds and anions the Slovak language resorts also to equivalent Latin roots in combination with corresponding prefix or suffix, e.g.: *oxide, oxonium, oxidane, hydroxide, hydroxyl, peroxide, peroxyacids, superoxide, suboxide; carbide, carbonato, carbonyl, carboxyl, carbamide, sodium bicarbonate; hydride, hydrone, hydrogenacid, hydrogenperoxide; nitride, nitryl, nitrosyl, nitrato, dinitrogen*. But in case of H_2NO_2 it is possible to use both Slovak and Latin roots: *hydronitrous acid* as well as *nitroxylic acid*, in case of H_2SO_2 *hyposulfurous acid*, but also *sulfoxylic acid*. And

[2] In case of HCl it is not called *chloro-hydride* but *hydrogen chloride* because hydrogen is a more electropositive part of the molecule.

[3] In reference to the Czech nomenclature Zoch wrote in the introduction of his nomenclature proposition that "Czech nomenclature is in many respects so complete that it will surely become a basis for all Slavic nomenclature which will hold true especially for the chemical one" (Zoch 1861).

last but not least, Slovak benefits of the treasure of Classical lexical heritage for distinguishing the type of compound which comprises the molecule of water H_2O—besides the general usage of terminologised Slovak word *voda,* the designation *hydrate* (from Greek word ὕδωρ) is employed within the nomenclature of crystal hydrates, while the nomenclature of coordinated compounds shows the Latin influence—*akva* (from the Latin word *aqua*).

The best publicly known elements of the Czech and Slovak chemical nomenclature are valence suffixes *-ný, -natý, -itý, -ičitý, -ičný/ečný, -ový, -istý, -ičelý,* which are used to form adjectives representing a part of the chemical name and which denote the valence of individual elements. Except for two of them, the suffixes also provide an example of a certain specification or modification of the lexical items of common Slovak language. No matter what function they have in general language, in chemical nomenclature they acquire the relational character, because "they precisely denote the relation between two elements in a given compound" (Horecký 1948). Besides their relational meaning, they include specifying and at the same time distinctive feature denoting the number of valence bounds from I to VIII by which the atom of an individual element binds with the rest of atoms in a compound. These generally known word-forming suffixes again come from Czech chemists J. S. Presl and V. Šafařík. In the 19th century these suffixes used to designate "the levels of abundance" or "equivalence ratios" of the elements in a compound. Development of chemistry necessitated the revision and modification of their meaning (not their formal change or coinage of new ones); today's set of valence suffixes in Slovak and Czech was finally modified by Alexandr Batěk and Emil Votočka and its usage was proclaimed officially obligatory from 1918 with the establishment of the Czechoslovak Republic (Zikmund 1961, p. 166). In contrast with the situation in other languages, Slovak or Czech chemists can express qualitative as well as quantitative composition and stechiometric valence of elements in a compound by employing the set of valence suffixes without resorting to numerals. On the other hand, it is sometimes pointed out that these suffixes lack international character; they have no equivalents in foreign languages though analogical efforts of introducing a similar set occurred for example in German (Wambach 2015).

Current chemistry necessitates the introduction of a nomenclature suffix "-utý" for cations [IrF_9 *"fluorid iridutý"* is *iridium*(*IX*) *fluoride*], corresponding to the oxidation number IX (Slavíček 2010). For now, this proposal has to be further considered in academic society.

The rest of Slovak word-forming suffixes (e.g. *-id, -ónium, -an, -yl*) and also prefixes used within the additive nomenclature system were taken over with their meaning from other languages, especially from English and French (Cottez 1994, p. 687); the role of these suffixes is to precisely delimit the type of compound while the prefixes are used mainly to specify the meaning, both in case of numeral or structural prefixes—e.g. *di-, tetra-, per-, tio-, seleno-, cyklo-*.

The real growth and boom of the Slovak chemical nomenclature and terminology came only with the end of World War II and re-establishment of the Czechoslovak Republic in 1945. Already in 1948 T. Krempaský, the then editor of the Slovak scholarly journal *Chemické zvesti*, initiated the creation of the Commission for harmonisation of chemical-technological nomenclature. Two years later with the death of Krempaský, the Commission was moved to the Institute of the Slovak Language (today's Ľudovít Štúr Institute of Linguistics, Slovak Academy of Sciences, hereinafter referred to ĽŠIL) and thus became the first of numerous terminology commissions organised by the terminology department of ĽŠIL. Headed by J. Gašperík and linguistic expert counsellor J. Horecký, the Commission published recommendations for creating rational names or notices on improper terms or orthography in *Chemické zvesti* from 1948 to 1950. In total, the Journal published 21 terminology articles. The Commission argued with the scholarly public as well as discussed definitions, their structure, new names and terms (Horecký 1956). If necessary, specialised subcommissions were established. In 1956, the totality of the Commission's work was published in a book entitled *Terminológia anorganickej a fyzikálnej chémie (Terminology of inorganic and physical chemistry*), which included 40 pages of nomenclature recommendations and rules, followed by the dictionary of terms and their definitions from the field of physical chemistry, inorganic chemistry, laboratory techniques and analytical chemistry.

Further development of the Slovak inorganic chemical nomenclature was partially influenced by politically motivated coordination with the Czech nomenclature but also by the IUAPC recommendations. However, in contrast with its beginnings the Slovak nomenclature became a model for the Czech nomenclature in 1960s and 1970s. In fact, the Czech nomenclatural commission, established in 1971, based its work not only on the results of previous commissions but also on the synthesising work of M. Zikmund, the member of the original Slovak terminology commission. The book was entitled *Názvoslovie anorganických látok* (*Nomenclature of inorganic substances*) and was published in 1961. Until 1970 it had seen four editions. Slovak chemical nomenclature was analysed further in following textbooks: *Ako tvorit' názvy a vzorce anorganických látok* (*How to form names and formulas of inorganic substances* by Šramko, T., Adamkovič, E. 1984, Bratislava: SPN), *Chémia. Chemické názvoslovie* (*Chemistry. Chemical nomenclature* by Matherny, M., Smik, L., Andruch, V. 1997, Prešov: TU Košice), *Názvoslovie anorganických*

látok pre gymnáziá (*Nomenclature of inorganic substances for secondary schools* by Sirota, A., Adamkovič, E. 2003, Bratislava: SPN), *Chemické názvoslovie a základné chemické výpočty (Chemical nomenclature and basic chemical calculations* by Poláček, Š., Puškáš, J. 2006, Bratislava: Príroda) and *Slovenské chemické názvoslovie v medicíne* (*Slovak chemical nomenclature in medicine* by Pavlovič, M., Holomáňová, A., Kadlec, O., Asklepios 2011.). There are also three university textbooks Názvoslovie anorganických látok: Princípy a príklady (Nomenclature of inorganic substances: Principles and examples. 2009, Bratislava: Univerzita Komenského) and Názvoslovie anorganických látok (Nomenclature of inorganic substances. 2011 and 2016, Bratislava: Univerzita Komenského).

Syntactic and word-forming structure of Slovak names in inorganic chemistry

Most names of the chemical compounds feature binary structure modelled on French, as the French nomenclature represents the oldest chemical nomenclature introduced already by A. L. Lavoisier in the 18th century. Then, just like today, the substantive in the structure used to express the type of a compound, while the adjective denoted the element forming this compound. From the linguistic point of view, these are the so-called multi-word units or lexicalised word combinations, which represent a common type of syntactic word-formation of more specific terms, as this structure enables to convey more explicit content. One member of this multi-word unit denotes the category or class into which the denoted entity is classified while the other one embodies the quality in the broadest sense by which the classified entity is specified.

1. Type: substantive + adjective

In case of multi-word units comprising the pre-modifier in the postposition, the Slovak chemistry probably adopted the French model and its typical French word order, i.e. the usual Slovak word order is reversed—the adjective is in postposition and agrees with the following noun in case, number and grammatical gender. However, the "normal" or usual word order of Slovak noun phrases can be found also in chemical terminology and nomenclature, but in this case the adjective, derived by means of the suffix *-ový*, does not refer to the valence, e.g. *kyselina bromovodík-ová* (*hydrobromic acid*), *chlór-ová voda* (*chlorine water*), *héli-ové jadro* (*helium nucleus*). The second reason can be found in the fact that the reversed word order is more convenient and transparent from the classification point of view.

Within this type, we distinguish two subtypes depending on which part of the unit was formed by composition

(a) Compound adjective

Adjectives created by means of compounding, e.g. $KAl(SO_4)_2$ *síran draselno-hlinitý* (*potassium aluminum sulfate*), NH_4MgPO_4 *fosforečnan amónno-horečnatý* (*magnesium ammonium phosphate*), usually comprise a hyphen between the two words, which expresses their equal relationship. Even the word order of the compound is meaningful, i.e. it depends on the electropositivity of the two elements. However, there are some examples of compound adjectives without the hyphen, for example—H_2SO_5 *kyselina peroxosírová* (*peroxysulfuric acid*). Compound adjectives do not have to be necessarily coined only on the basis of two elements'names, which can be seen for example in the nomenclature of coordination compounds, where as many as four root morphemes can be identified which refer to the element or group. The name is specified also by the numerical sign in combination with punctuation denoting the charge number: $[Co(H_2O)(NH_3)_3Cl_2]Cl$ *chlorid akvatriammin-dichloridokobaltitý*(1+) [*triammine-aqua-dichloridecobalt*(*III*) *chloride*].

(b) Compound substantive

Compound substantives in a multi-word unit or name are created by means of a hyphen or the infix *-o-*. For names of double and mixed salts or double oxides the hyphen is used: AlO(OH) hydroxid-oxid hlinitý [*aluminium*(*III*) *hydroxide oxide*], *HoFO fluorid-oxid holmitý* [*holmium*(*III*) *fluoride oxide*], $BiBr(SO_4)$ *bromid-síran bizmutitý* [*bismuth*(*III*) *bromide sulfuric*], the names of coordination compounds, which also include compound specifying adjectives, comprise also the infix *-o-:* $[Co(NH_3)_6]$ $[Cr(CN)_6]$ *hexakyanidochromitan hexaamminkobaltitý* [*hexaammine chromium*(*III*) *hexaammine cobalt*(*III*)], $[Cu(NH_3)_4]$ $[PtCl_4]$ *tetrachloridoplatnatan tetraamminmed'natý* [*tetrachloride platinum*(*II*) *tetraammine copper*(*II*)].

2. Type: substantive + substantive

Multi-word units in Slovak can be formed also by using a post-modifier. However, a pre-modifier expressed by an adjective usually enables to shorten an accurate but long name (e.g. *area load vs. surface load*). In some cases, both types of multi-word units can be formed, but they can differ in meaning. In Slovak terminology, it is not unusual to have these structures with post-modifiers in the dative and accusative cases (Slovak as a synthetic language has seven cases altogether), but chemistry is dominated by the post-modifiers in the genitive case. From the general point of view, the function of this genitive case is that of explanation. Within the class of binary compounds (*hydrides, borides, nitrides, arsenides, carbides, silicides*) the union of two substantives is an exception, which signals that it is impossible to clearly determine the oxidation number of atoms of individual elements in a given

compound, e.g. *Cr_4B borid tetrachrómu* (*chromium boride*), *Fe_3C karbid triželeza* (*iron carbide*), *CuP_2 difosfid medi* (*copper phosphide*). Syntactic structure is therefore meaningful; the number of atoms of these elements is specified by the Greek numeral prefix. Post-modifier in genitive case is employed also for naming compounds of radicals by means of the suffix *-yl*, complex compounds, complex cations and also compounds of hydrogen and oxide (*peroxid vodíka/hydrogen peroxide*).

3. Type: substantive + substantive + adjective

Rare three-word names are formed by combining both previous types of multi-word units, thus they include pre-modifier as well as the post-modifier. They can be found in the nomenclature of kryštalosolváty (hydrated compounds), e.g. *$CaSO_4 \cdot ½H_2O$ hemihydrát síranu vápenatého* (*calcium sulfate hymihydrate*), acid amides and imides, *e.g. $SO_2(NH_2)_2$ diamid kyseliny sírovej (sulfonyl diamide*).

4. Type: substantive

One-word names of compounds represent a combination of two elements'designations in one word. However, it is a non-productive and non-systematic way of formation of chemical elements. The best known example occurs with the names of compounds of hydrogen and non-metals, which comprise the infix *-o-* (which links the names of non-metals with hydrogen): *HF fluorovodík* (*hydrogen fluoride*), *HCl chlorovodík* (*hydrogen chloride*), *HBr bromovodík* (*hydrogen bromide*), *HI jodovodík* (*hydrogen iodide*), *H_2S sírovodík* (*hydrogen sulfide*), *HCN kyanovodík* (*hydrogen cyanide*).

This method was employed also for naming amines of halogens (compounds formed by substituting the atom of hydrogen by sulfur in a binary compound, e.g. *$NHCl_2$ dichlóramín is dichloroamine*) or in the substitutive nomenclature of binary compounds, e.g. *dichlórsulfán is SCl_2 sulfur dichloride, P_2I_4 tetrajóddifosfán is diphosphorus tetraiodide.* In unique case of metal carbonyls with oxidation number of central atom 0, the designation can be created not only with a post-modifier within a multi-word unit [*$Fe(CO)_5$ pentakarbonyl železa is iron pentacarbonyl*], but also as a compound (*pentakarbonylželezo is iron pentacarbonyl*).

Conclusion

In accordance with the 18th century efforts to introduce a nomenclature that would reflect as perfectly as possible the classification of compounds in comparison with trivial names, there arose names of compounds that can stretch as long as one line and more: [$IrCl(CO)HF(PPh_3)_2$] *fluorido-hydrido-chlorido-karbonyl-bis*(*trifenylfosfán*)*iriditý komplex is carbonyl-chlorido-hydrido-fluorido-bis*(*triphenylphosphine*)*iridium*(*III*) *complex* (note different ordering of ligand names not only due to their different Slovak and English names but also due to the differences in alphabets: the letter *ch* follows *h* in Slovak alphabet). Lavoisier foresaw this complication and already in 1787 drew the attention to the fact that accumulation of substantives and adjectives, derived from Greek and Latin, which he considered to be improper, was not easily to learn and pronounce (Cottez 1994). These kinds of designations are in direct contradiction with the so-called language economy of expression. Moreover, the complexity of naming rules does not contribute to the flawless communication either; sometimes, even members of scientific public make "nomenclatural mistakes". The penetration of chemistry into other areas (e.g. pharmacy or medicine) results in creation of trivial, generic or commercial names and their usage instead of the long systematic designations (Wright 2001, p. 222). Precise, unique and unambiguous designations are not fit for example for communication in healthcare environment which prefer conciseness and shortness. WHO (World Health Organization) even recommends the modification of orthography and spelling in order to facilitate the translation and pronunciation of terms and names.

From the point of view of the controlled language, the existence of several parallel naming systems in chemistry (conjunctive, substitutive, additive, etc.), which can assure equal clarity, may constitute a handicap for communication and specialised information transfer. Different situational and communicative contexts as well as aims and publics require different lexicon. However, the interdisciplinary dimension of nowadayś Slovak nomenclature of inorganic chemistry and terminology shows that it can be (and is) applied within a specified areas of usage, mainly the educational (from basic to advanced levels) and scientific ones. An overall summary of chemical nomenclature can be found in Principles of Chemical Nomenclature (Leigh 2011).

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