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## **English-Georgian and Georgian-English explanatory online dictionary of chemistry terminology**

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## **English-Georgian and Georgian-English explanatory online dictionary of chemistry terminology**

### **ABSTRACT**

The new English-Georgian and Georgian-English chemistry explanatory dictionary has been created on the base of IUPAC recommendations and published online. This is the first attempt to follow one of the priorities of the Georgian language state program – harmonization and standardization of modern field terminology.

The structure of the dictionary follows the same principle of word-article construction as the English dictionary, and includes a lexical unit, a subfield of chemistry or a related discipline, a definition/article of a term, a section “see also” and a list of references. During online dictionary development have been carried out editing of existing terms and synchronization with international terms, correcting the terms according to the established norms of transliteration-transcription of the English phonetic system, introduction and establishment of new terms, overcoming parallelism and synonymy in terminology, etc. The dictionary reflects more than 5000 terms with their definitions.

**Keywords:** *chemistry terminology; Georgian terminology; explanatory online dictionary*

### **Introduction**

The dictionary was created based on the recommendations and proposals suggested by the permanent commission of the international union of pure and applied chemistry IUPAC ([www.iupac.org](http://www.iupac.org)) responsible for the development of new chemistry terms, correct and international recognition of concepts, laws, definitions, etc.

The Georgian-English and English-Georgian chemistry explanatory online dictionary is created based on the terminology developed by IUPAC and published as a "Gold Book" (Gold Book,

IUPAC, 2014). Online dictionary is located at the web address: [www.chemistry.ge/dictionary](http://www.chemistry.ge/dictionary) and has a free access for any interested person.

The dictionary was developed at the Agricultural University of Georgia with the financial support of Shota Rustaveli National Science Foundation of Georgia. This is the first attempt to follow one of the priorities of the Georgian language state program – harmonization and standardization of modern field terminology. An extended editorial board with the participation of leading specialists from various universities, both chemists and terminologists-linguists, has been involved also in the process of developing the dictionary.

### For the history of the issue

Terminological explanatory online dictionary of chemistry in Georgian language is being created for the first time, although the creation of a terminological dictionary has a long history. Complete and detailed discussion regarding the matter is presented in the thesis written by M. Kikvadze "Structural-semantic analysis of chemistry terminology" (Kikvadze, 1995, 12-34). Accordingly, we were completely relying on the references and facts provided by the scientist. The one of the first attempt to come up with Georgian terms is made by Vakhtang VI tried in the work "The Book of Mixing Oils and Chemistry", which was republished in 1981. A large part of the terms presented in this book has survived until today in the science of chemistry (**vercxlisçqali** – mercury, **ḵala** – tin, **rḵinis žangi** – iron rust, **nišaduri** – ammonia, **ḵapuri** – camphor, **gogirdi** – sulphur, **spilenzi** – copper, **tqvia** – lead, etc).

Researchers have noted that in the second part of Vakhtang VI's book, during discussing the issues of chemical processing of oils, instead of Eastern (Persian-Arabic) vocabulary, he uses European terms: antimony, trementhim, lavender, etc. However, the preference for Georgian terms is also obvious. It can be said that Vakhtang VI is a continuation of the historical tradition of term creation. We have in mind the terminological activity of medieval figures – Efrem Mtsire, Ioane Petritsi, when they created a unified philosophical-theological terminological system by borrowing terms from the Greek language, as well as by means of words and word-formation models found in the depths of the Georgian language.

A new stage in the development of chemistry terminology relates to the turn of the 19th and

20th centuries when a discussion was held in Georgian magazines and newspapers about the establishment of Georgian terms in various fields of natural sciences. The articles of Vasil Petriashvili, a chemist, were especially distinguished. He developed the Georgian terms of chemistry on a scientific basis in his famous works: "Setting wine" (1895) and "Milk and its various applications" (1898). It is noteworthy that the term "jangbadi" V. Petriashvili established it instead of the previously used "mjavbadi".

Naturally, a new stage in the creation of the scientific language of chemistry began in 1918 with the establishment of the Georgian State University, which was headed by the chemist Petre Melikishvili. He participated in the work of the Commission for the development of scientific terminology, as well as once chaired the Commission of chemical terminology for public schools.

Terminological work based on scientific principles began in Georgia from 1920 after establishment of The Technical Society of Georgia (head G. Gedevanishvili, secretary – chemist Vasil Kakabadze).

Georgian equivalents of technical terminology became the most pressing issue after foundation of Georgian national schools and switching the education system from Russian to Georgian.

Indeed, very soon this society published a Russian-Georgian terminological dictionary "Glossary", which combined several fields, including chemistry. This dictionary played a major role in the creation of Georgian technical terminology (Karosanidze, 2020, 4-32). The position of the compilers of the dictionary was strongly positioned: to find Georgian analogues of international science and technology terms for avoiding usage of foreign ones.

In the scientific literature It has been rightfully noted that such an approach to term creation is conditioned by the task, the solution of which was necessary in the shortest possible time. The creation of Georgian terms on nearly bare foundation required a search for words not only in the literary language, but also in dialects of Georgian Language, research into the word-formation models of the Georgian language and their corresponding uses. This happened simultaneously with A. Shanidze, V. Topuria, Arn. Chikobava performing scientific research of the structure of the Georgian language, form and word formation models, language capabilities. Thus, "Glossary" could not be protected from improper forms and artificially created words. So, while working on chemical terms, compilers renamed many chemical terms and introduced many artificial ones.

The issue remains controversial: was it necessary to refuse to fully borrow terms or not? This question is still relevant, because modern trends present the problem of term creation in all languages, including Georgian. The internationalization of terms began in the 20th century, but it is also clear that the national scientific school cannot exist without a corresponding Georgian metalanguage. Vukol Beridze, who headed the scientific terminology of the Institute of Linguistics of the Georgian Academy of Sciences, developed a novel approach to the terminology of chemistry. It has already been decided that introduction and implementation of international terms was necessary. However, one debatable issue arises here: these international terms were introduced through the Russian language, which means that the features of the Georgian phonetic system and issues of transliteration were often neglected. We will refer to this issue below. Here we will note that both directions of chemistry terminology development (internationalization and nationalization) coexisted. For example, in "Technical Terminology" (1957) published under the editorship of Prof. R. Nikoladze, as well as in "Dictionary of Chemistry Terminology" (1970), both, the motivation to give priority to Georgian terms and the choice of Georgian word formation models, can be seen.

In fact, subsequent editions of the Georgian Terminology of Chemistry were based on the Dictionary of Chemistry Terminology mentioned above. Authors of textbooks also used this dictionary. However, in 1975 "English-Georgian short dictionary (for biologists and chemists)" was published by Ts. Menabde. It was an interesting attempt in terms of creating a direct correspondence with the English language independently of Russian.

In independent Georgia, the issue of updating and developing national scientific terminology, including technical terminology, became relevant again. Following the development of chemistry, its adjacent or subdisciplines, new terms flow from European languages. It was necessary to reconcile the existing terms with the European ones, including those universally recognized by IUPAC. In 1992, it was decided to prepare a four-language terminological dictionary of chemistry by the suggestion of the relevant departments of the National Academy of Sciences of Georgia. Accordingly, the scientific terminology department of Arnold Chikobava language institute with close collaboration with large team of chemists prepared and published "Four-Language Chemical Dictionary" in 2004, edited by Acad. G. Tsitsishvili. The dictionary is based on the previously published dictionary (in 1970) but along with the Russian language, English-German terms are

also presented. Four-Language Chemical Dictionary includes about 8000 items.

According to the preface, the names of chemical compounds are included in both historically established names as well as "modern rational nomenclature given in appropriate language and responding to the recommendations of the International Union of Pure and Applied Chemistry (IUPAC)" (Tsitsishvili & Gambashidze, 2004, VI)

All chemistry dictionaries are only translational, and in fact, we still didn't have an explanatory terminological dictionary, unless we consider S. Adamia's "Dictionary with short definition of chemical terms" (1998) containing about 1000 terms, "Explanatory dictionary of soil science and Agrochemistry" published by O. Oniani and R. Petriashvili in 1981.

The era of modern technologies has presented new opportunities and ways of development, including in terminological activities. The digitization of metalanguage and the creation of online resources is becoming more and more relevant. The English-Georgian-Russian online dictionary of technical terminology has been actively used for several years (<https://techdict.ge>) containing 18 thousand-word articles as well as accompanying small definitions in some cases. Although this dictionary mainly contains electronic, computer, engineering and construction, communication and information technology, automobile, railway technology, etc. terms, common terms for chemistry and other fields of natural science are also abundant (Tech Dictionary, 2015-2023)

Georgian term bank is being created at the Arnold Chikobava Institute of Linguistics since 2014. It will combine standardized terms of all fields of science and technology, including chemistry. The issue of terminological standardization of chemistry textbooks became the subject of discussion at terminological conferences organized in last year's (Metreveli, 2020, 282-285). Modern terminological policy in all countries is based on a single term bank, which ensures compliance and harmonization of standards. Our dictionary will also be reflected in this term bank in the future.

### **The structure of the dictionary**

Considering the history of the issue and the modern challenges, the explanatory online dictionary of chemistry terminology presented by our group is an attempt to continue the terminological tradition and develop the natural science metalanguage. The structure of the dictionary follows the same principle of building the word-article of the English language

dictionary. Namely, under the lexical unit, the chemistry subfield or adjacent discipline is indicated. Then follows the definition/article of the term; After the definition "See also" section may occur, and finally – the references are listed. It should be noted that additional Georgian sources have been added to the list of references in some cases such as "Four-Language Chemical Dictionary" (2004), "English-Georgian-Russian technical online dictionary", etc. Sometimes the individual terms are accompanied by markers: less desirable, obsolete, use is strictly not recommended, ambiguous term – it is recommended to stop using the term. Despite such qualifications by the IUPAC, part of the non-recommended terms is actively used in Georgian terminology, therefore, the editorial board of the dictionary considered it necessary to leave them at this stage, because the issue requires further additional research.

### **Methodology and research issues**

The development of chemistry terminology is not only a matter of translation, but a word-creative process based on scientific principles, considering as much as possible: the structural-semantic features of the Georgian literary language, traditional approaches to term creation, modern scientific and technological challenges. In addition, our dictionary is the first explanatory dictionary, which reflects the possibility and perspectives of development of the metalanguage of chemistry.

As mentioned above, the source language for existing normative dictionaries was Russian, which is why we tried to methodically solve the following issues:

- In existing chemistry dictionaries, for objective reasons, Georgian terms are often based on Russian and Soviet terms. In the latter, there is often a big divergence with international terms.
- The terms in the old dictionaries do not meet the established norms of transliteration-transcription of the English phonetic system into Georgian.
- The one major problem with chemistry terminology is that there are new terms that have not yet entered any dictionary.
- The explanatory part of the term is no less problematic. On the one hand, it is necessary to edit the outdated definition, on the other hand, to adequately translate

the definitions of completely new terms.

- In terminology, it is important to overcome parallelism and synonymy.

As mentioned above, the main guide of solving these issues was the relevant IUPAC recommendations. Accordingly, the first steps were taken in the preparation of the "Four-Language Chemical Dictionary" (2004), although some terms required revision. Also, following the development of different directions of chemistry, it was necessary to introduce new terms.

In the article we will try to present the novelties we offer to the users, through this dictionary, according to the tasks.

## Main body/research findings

### a. Editing of existing terms and synchronization with international terms.

Over the years, "complex ether" and "simple ether" have been accepted, the international equivalents of which are "ester" and "ether". The preference of the term ester is unequivocal from a chemical point of view. In addition, the definitions "complex" and "simple" in front of ether do not show anything based on the molecular-structural content by which ester and ether differ from each other, nor can an analogue be found in other languages. Linguistically, from the terminological point of view, which implies the simplicity, transparency and brevity of the term, the superiority of ester and ether over "complex ether" and "simple ether" (interpretation) is obvious.

In English-language literature, the term **threshold** is often used in combination with different terms, which in Georgian-language literature is translated as "**zyvruli**". The term "marginal value", in turn, is also used in the sense of "extreme edge", "borderline". In contrast, the term threshold allows that there may be a value greater (or less) than it, but it represents a "threshold" value that requires some effort to overcome. For example, for the term energy threshold used in radiochemistry, a more relevant Georgian equivalent would be "**energetikuli zyurbli**" and not "**energiis zyvari**" or "**zyvruli energia**", because it is the threshold kinetic energy of an incident particle or the energy of an incident photon, below which a defined process cannot be carried out.



Similarly, the term **apparent** is often used with various physical quantities to indicate that the value of the measurement is "approximate". Therefore, it was used in the form of "*pirobiti*", although in a number of cases it would be better to use the term - "*močvenebiti*". For example, in liquids: **apparent viscosity** - "*močvenebiti sibilanṭe*", because it is the ratio of tension to the speed of deformation and is calculated by measuring forces and velocities, assuming that the fluid is Newtonian. If the fluid is not actually Newtonian, then the "*močvenebiti sibilanṭe*" depends on the type and dimensions of the apparatus used.

The editing also affected the terms denoting the fields of chemistry. For example, liquid chromatography according to the "Four-Language Chemical Dictionary" (2004)" is "*txevadi kromaṭograpia*", and many use it that way, although "*sitxuri kromaṭograpia*" is more relevant. It is also better to use the term "*aṭmosperos kimia*" instead of "*aṭmosperuli kimia*".

#### **b. Correcting the terms according to the established norms of transliteration-transcription of the English phonetic system.**

Obviously, the dictionaries created in the 50s and 70s of the last centuries were based on the Russian-language chemistry terminology, and therefore the term was introduced by Russian transliteration. For example, under the influence of Russian, "crown-ether" is adopted in the Georgian scientific literature as "*kraun-eteris*". Fortunately, the rule of writing "t" as "ṭ" and "th" as "t" when introducing international terms into Georgian, has already been established (e. g. Methane - *metani*, butane – *buṭani*), although it is still problematic terms containing symbols c, cr, ch, q which need to be standardized. As an example, we can cite *akvageli*. "aqua" is often found in the Georgian scientific and non-scientific vocabulary as "*aḱva*", however, if we consider the Latin origin of the root of the word, the correct form is "*akva*" and, therefore, it should be "*akvageli*". Obviously, all terms that include "aqua" should be specified similarly. For example, aquation refers to the joining of one or more integral (entire) water molecules to other particles with or without replacement of one or more other atoms or groups. In Georgian, it should be mentioned with the term "*akvanireba*".

### c. The issue of introduction and establishment of new terms

Recent trends related to the introduction of new terms are direct use as borrowed terms, or the author of a Georgian text (scientific paper, textbook...) uses it in a translated/suitable form according to his/her own opinion (sometimes even correctly), although it does not find universal recognition in the field. At the same time, the Gold Book of IUPAC, possessing of more than 5000 terms, includes up to 10% new terms and updated wording/definition. Therefore, this share of terms has not been translated into the Georgian metalanguage at all.

Of course, it is not always possible to create adequate Georgian forms for completely new terms, and borrowing is inevitable. This is the most difficult and responsible process, that's why in the article we will focus on the rules of creating terminology.

#### Georgian terms

Of course, creating Georgian terminological equivalents is preferable, although controversial. As an example, we can cite the term “**attenuance**”, which is analogous of “**absorbance**”. however, unlike it, it takes into account effects caused by scattering and luminescence, and corresponds to a smaller physical value. Therefore, we consider it fair if it is established in the form of „**šesusteba**“ in Georgian. It should be noted that the term **attenuance** has replaced the previously widely established term **extinction** in the English language, which in Georgian was used directly as „**eksťinkcia**“ or “**čaxšoba**”.

In atmospheric chemistry there is a term „**entrainment**“ which means the process of forming a mist or fog, namely droplets of a liquid carried off by the vapours of a boiling liquid or from a liquid through which bubbles of gas or vapour are passing rapidly. After consideration, we decided it is appropriate to establish the term „**čartaceba**“ in Georgian.

#### Mixed model

It is an experienced method in creating terminologie, when the root and affixes of the term are different linguistic units, in our case – English-Georgian. As a result of the achievements of theoretical and applied chemistry in recent years, it is often impossible to find the perfect Georgian corresponding forms of the new terms that have appeared in the international literature.

Therefore, wherever possible, we tried as much as possible to use the Georgian root when creating the term. For example, in stereochemistry, the terms “**antarafacial**” and “**suprafacial**” are used to describe the specific spatial structure of a molecule. The mentioned terms are taken in a borrowed form in many languages, however, we believe that instead of “**anṭarapacialuri**” and “**suprapacialuri**“, it is better to use “**anṭarasaxovani**” and „**suprasaxovani**“ in Georgian.

When creating the term, it becomes vice versa: the root is a foreign language, and the producing affix is Georgian. For example, one of the new terms is “**anation**”, which refers to the replacement of the water ligand in the coordination ring with an anion, and its corresponding Georgian term would be „**anionireba**“.

In some cases, we had to create a new Georgian term based on the content of the definition. For example, the term „**concerted reaction**“ is used to denote a chemical reaction in which the breaking of several chemical bonds and the formation of new one take place simultaneously with a certain regularity and sequence. We considered that a better Georgian term to express the given process would be “**orkestrirebuli reakcia**”. It is true that these words are borrowed historically, but they are already established and are natural for the Georgian language.

## Borrowing

We have already mentioned that borrowing a term is one of the ways to create a term, and in this regard, we could not avoid such words. For example, the term effluent in the online dictionary of technical terminology is given only in the meaning accepted in ecology as “wastewater”. In chemistry, particularly in chromatographic analysis, it also refers to the mobile phase that leaves the column. Thus, it was decided that in chemical texts this word would be directly borrowed as „**epluenti**“.

In the chemistry of mechanisms, the term “leaving group” is well known. But the development of this branch of chemistry introduced some new terms. These are „**electrofuge**“ and „**nucleofuge**“. Both are also used to refer to the “leaving group”, although the new term specifies the nature of the leaving group and makes the reaction mechanism clearer. In particular, electrofuge refers to a leaving group that does not carry a bonding electron pair. For example, in the nitration of benzene with  $\text{NO}_2^+$ ,  $\text{H}^+$  is **elektropuži**. Therefore, the adjective production of electrofuge would be

## *elektropužuri.*

The term „**effector**“ has been used for years in biochemistry to denote a small molecule that increases (activator) or decreases (inhibitor) the activity of a protein (allosteric) by binding to the regulatory site of the protein (which is different from the catalytic site for substrate binding). This term was not included in any technical dictionary, although it was still used informally. And now, we would like to offer, officially establish the term "effector" through our dictionary.

### **d. Overcoming parallelism and synonymy in terminology.**

Consensus of experts is very important to overcome parallelism and synonymy wherever possible. Synonyms can exist in both Georgian and borrowed terms, but for the final solution we turned to the following way: We were submitting parallel forms to the editorial board of the dictionary for discussion and final decision. In case of disagreement the established form was chosen by voting. For example, from the existing parallel forms for the term: **solid support**: *maṭarebeli, mḡari maṭarebeli, mḡari maṭrica, mḡari sarčuli*, „**mḡari sarčuli**“ was adopted as the final form (71.4%). For the term **penetrants** the following forms were presented: *penetrantebi, šemyčevi nivtiereba, šemyčevi naertebi, šeyčewis agentī*. After discussion by the commission, preference was given (over 50% of votes) to the form close to the international term – „**penetrantebi**“. In the first case preference was given to the Georgian matching, while in second case the borrowed term prevailed. In stereochemistry a number of terms are used to denote the conformational forms of molecules. This time we want to focus on two of them, such as **eclipsed** and **bisecting**. The first of them can be found in practically all textbooks of organic chemistry, although with different Georgian equivalents: „*čamoparebuli*“, „*daekranebuli*“ and „*eḡranirebuli*“. We consider it appropriate to establish the term „**čamoparebuli**“ to correspond to eclipsed, because besides being a Georgian word, it accurately describes the physical essence of the conformation for which it is used. With a similar approach, for the term **bisecting** „**dacurebuli**“ should be established in Georgian.

We have noted that the term "lethal dose", "lethal concentration" etc. has been used for a long time in the medical and chemical literature. We believe that replacing the word "lethal" with completely Georgian equivalent „**sasikvdilo**“ is more appropriate.

#### e. A change in the definition of the term.

Chemistry is a constantly and rapidly developing science and sometimes it happens that some term, concept, law, etc. undergoes further change/improvement of definition in accordance with modern approaches of science. As one of the examples, the well-known "Mendeleev periodic system", international analogue of which is the "periodic table of elements", can be mentioned. The definition of one of the fundamental concepts of chemistry, "mole", has been changed and clarified. Namely, according to the latest IUPAC recommendation, "**Mole** is the amount of matter in a system that contains as many elementary units as there are atoms in 0.012 kg of carbon-12."

The dictionary is descriptive. Therefore, word-articles are translated according to the following principle:

A. If the definition is long and encyclopedic by nature, we shorten it and leave only the part that directly refers to the term.

b. Sometimes the explanation is accompanied by notes. Here too, we translate these notes according to the needs.

Translation is a complex process, which is caused by polynomial terminological phrases, as well as different syntactic constructions of English and Georgian languages. We try to avoid calquing, but this is not always possible. Sometimes the term is a whole sentence, for example, "**gaumžobesebuli kanonikuri variaculi gardamavali mdgomareobis teoria**", cf.: Eng: "improved canonical variational transition state theory" we also have polynomial terms in the definition: კანონიკური ვარიაციული გარდამავალი მდგომარეობის თეორიის მოდიფიკაცია, რომლის დროსაც ზღვრული ენერგიის ქვემოთ ენერგიებისთვის გამყოფი ზედაპირის პოზიცია გამოიყენება/მიიჩნევა მიკროკანონიკური ზღვრული ენერგიის პოზიციად.. Cf.: A modification of canonical variational transition-state theory in which, for energies below the threshold energy, the position of the dividing surface is taken to be that of the microcanonical threshold energy..."

It is important to replace the Georgian vocabulary in the definition to convey the meaning of the term. For example, the term „**imobilizebuli paza**” is established in biochemistry-biotechnology, but in the definition part, we replaced immobilization with the Georgian equivalent „**damqno**

(grafting)": უძრავი ფაზა, რომელიც დამყნობილია სარჩულის ნაწილაკებზე ან სვეტის მილის შიდა კედელზე.." Cf.: A stationary phase in which is immobilized on the support particles, or on the inner wall of the column tubing..."

## Conclusion

Thus, the dictionary reflects more than 5000 terms with their definitions. Georgian-English and English-Georgian dictionary is the first Georgian explanatory online dictionary of chemistry. The terms collected in it correspond to the international standards of terminology. The creation of this dictionary is based on scientific research according to the directions of chemistry, as well as Georgian terminological experience. With the issues presented in the article, we tried to present the research novelties of the dictionary. On the one hand, a large part of the existing terms has been edited in terms of clarifying the content and correcting the spelling (transcription- transliteration), on the other hand, new terms have been introduced by creating borrowed and Georgian equivalents. We think this dictionary will fill the gaps in the field. In addition, the online dictionary allows us to make changes to it following the comments of users and specialists. Naturally, we will submit the finished dictionary to the Expert Commission of the State Language Department for approval.

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