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**PASSIVE VOICE IN CONTEMPORARY RESEARCH ARTICLES  
(EXEMPLIFIED BY WASTEWATER TREATMENT ARTICLES)**

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This paper presents a corpus-based analysis of the passive voice use in contemporary research articles. The passive voice use in research articles is a controversial issue, and nowadays many journals strongly recommend minimizing or avoiding the passive. However, in many cases, the flow and logic of scientific discourse require passive voice. Hence, the article aims to derive the trends in passive voice use. The analysis was based on a corpus compiled from 50 research articles on wastewater treatment published in 2016-2017. The lexemes were marked with part of speech tags, which were generated by a program in R programming language and used to calculate the frequencies of tenses, active and passive voice. The use of passive voice is observed in about 31% of all tenses utilized in the corpus. In article sections, the frequencies are different: in Abstract and Conclusions, one passive phrase appears per three phrases in the active voice, in Materials and Methods, two sentences in passive are used over three sentences in active; in Results and Discussion section, three passive verbs appear over eight verbs in the active voice. The corpus showed a lower rate of passive voice (20%) compared to the Longman corpus (25%) and the previously published research papers. The recommendations for the passive voice use were developed, including the use of personal pronouns for avoiding the excessive passive voice use.

*Key words:* corpus linguistics, academic writing, passive voice, frequency analysis.

Nowadays, the scientific community is global, and researchers have to be able to report their results in English, therefore the interest to academic English has significantly increased. Numerous guides in academic writing have been published (D. Biber et al. [3], A. Wallwork [12], R. Weissberg [13], J. M. Swales [11]). However, due to the application in various areas of science, economics, and humanities, the academic language still attracts the attention of linguists, and the Ukrainian linguists are not the exception (T. Yakhontova [15], O. Ilchenko [14], N. Bidnenko [5]). However, no systematic studies describing dynamic trends of the academic language in experimental articles have been published. The passive voice in research papers is still an ongoing discussion, and the paper endeavours to address this issue.

The articles related to wastewater treatment were selected as the illustrative material since this area is multidisciplinary: the authors are chemists, biologists, physicists, engineers, and even mathematicians. Hence, the regularities of academic English can be used in many applied sciences, which require the description of the experimental results.

The papers for the linguistic analysis were chosen using the nonprobability purposive sampling. The papers were selected from *Science Direct* [9], the world-wide database of scientific, technical and medical research. The articles were from the peer-reviewed journals with high impact factor. To be selected for the analysis, the article should meet the following criteria:

- contain the phrase “*wastewater treatment*” in the article title or abstract;
- be an original research article, not a review or short communication, and include the laboratory experiment;

- be published in 2015-2017, which ensures the modern style of academic writing;
- at least one author should come from an English-speaking country (UK, USA, Canada, Australia, New Zealand). Although the majority of articles are written in co-authorship, it is a rule of a thumb that the native speaker writes the manuscript.

Using this method, 50 papers were chosen and used for the analysis. The Abstract, Materials and Methods (M&M), Results and Discussion (R&D), and Conclusion texts were cleaned from tables, figures, numbers and various symbols, which do not have the lexical meaning. These sections were used to compile the corpora with the respective names. The corpora included approximately 215,000 lexemes.

The lexemes in the corpora were tagged with part-of-speech (POS) tags using *R* software (the programming language used for the researcher-oriented statistical studies, which has recently been applied in linguistic research). Figure 1 presents the *R*-code for corpus processing, Figure 2 presents the example of the POS-tagged corpus. The *R*-code realizes tagging the text with parts of speech [8, p. 70], which enables grammatical features analysis.

```
s <- Corpus(DirSource("D:/R/"), readerControl = list(language = "en"))
tagPOS <- function(x, ...) {
  s <- as.String(x)
  word_token_annotator <- Maxent_Word-Token_Annotator()
  a2 <- Annotation(1L, "sentence", 1L, nchar(s))
  a2 <- annotate(s, word_token_annotator, a2)
  a3 <- annotate(s, Maxent_POS_Tag_Annotator(), a2)
  a3w <- a3[a3$type == "word"]
  POSTags <- unlist(lapply(a3w$features, `[`, "POS"))
  POSTagged <- paste(sprintf("%s/%s", s[a3w], POSTags), collapse = " ")
  list(POSTagged = POSTagged, POSTags = POSTags)
}
tagged_str <- tagPOS(s)
tagged_str
```

Figure 1. Customized *R*-code for part-of-speech tagging.

The/DT reliability/NN analyses/NNS showed/VBD to/TO be/VB a/DT simple/JJ and/CC straightforward/JJ methodology/NN that/WDT can/MD be/VB used/VBN by/IN sanitation/NN companies/NNS to/TO select/VB appropriate/JJ wastewater/NN treatment/NN processes/NNS for/IN reuse/NN purposes/NNS ./.

Figure 2. Fragment of the tagged corpus

The use of passive voice is recognized as a characteristic feature of research articles language [2, p. 103]. The scientific discourse requires objectiveness, and the role of an agent (a person) is not important. Passive constructions provide an abstract presentation of information. As it was denoted by Biber & Conrad [4, p. 123]: “*Even more importantly, passive voice allows concepts and objects (rather than people) to be the grammatical subject of the sentence, making the discourse topic clear*”.

However, the recent recommendations for scientific writing suggest avoiding the passive voice. Nowadays, linguists argue on the issue. Sheffield in [10] presents the numerous scientific papers, which discuss the issue. The active voice is favoured for clarity and conciseness. Ding [7, p. 122] studied the historical aspects of passive voice use in scientific writing. According to his data, the corpora of 18th-19th century preferred active voice, and the move towards passive took place in the 20th century. The author explained this by the change of the discourse character when objects, materials, and things were to represent the world. As a result, the research articles became objects- and things-oriented.

Alvin [1] in his article analysed a corpus of 60 scientific articles in different areas (nature, science, medicine, published in 2013). The author separated the journals into two groups:

- Group A included journals that stated in the instruction for authors to use active voice wherever possible;
- The journals of Group B did not have a specific statement about avoiding passive voice.

The author identified the average value of 30% passive clauses in Groups A and B, and Groups A and B had 26% and 34%, respectively. The most frequent use of passive was observed in *Journal of Combinatorial Science*, and *ChemPhysChem* (about 35%). However, the author noticed significant variance between the volumes. The main conclusion of the article was “*the presence of explicit statements on the use of grammatical voice does have an impact on the writing*”. The detailed analysis of the clauses in all the studied papers indicated that the authors use the passive voice, wherever they find it appropriate, despite the editorial preferences.

The use of the active voice has several preferences over the passive. Apparently, the active voice makes writing more comprehensive, and phrases are less awkward. In addition, the phrases are also less ambiguous, and the reader can determine the one who has formulated the idea [6, p. 68].

Basing on practical considerations, the authors should choose the passive voice in the discussion of the previously obtained results that have not been confirmed universally applicable; and when the passive statement is more clear and concise. In academic writing, the authors should follow the journals' instructions regarding active and passive voices.

The recent trend in scientific writing displays preference over the active voice use. The active voice identifies the agent of the action, use of active forms helps to shift the verb closer to the subject:

*“We regard the latter possibility less likely as chemicals that are not AhR ligands generally are expected to reduce the activity...”* [19, p. 56].

In this case, the use of the active voice elevates the author's contribution. On the contrary, the statement: “*The latter possibility was regarded less likely...*” might be confusing since it is not clear who reached this conclusion, the author or the other researcher.

However, there are cases when passive voice is fully justified. Some statements are more accurate and precise with passive voice:

*“Likewise, DEET was not significantly transformed...”* [21, p. 138].

*“When T. versicolor was grown in carbon-amended secondary WWTP effluent and subsequently spiked with a complex mixture of common ECs, the overall estrogenic activity of the mixture was rapidly reduced.”* [21, p. 139].

In these examples, awkward constructions with unnecessary information would be required in the active voice. Blackwell [6, p. 68] states that “*the most famous, elegant and moving passages in English are in passive voice, partially or entirely*”. Therefore, despite the recommendations [3, 12-13], passive voice is acceptable.

Figure 3 illustrates the passive voice use in wastewater treatment corpus. The passive voice use was analysed in main and subordinate clauses. The analysis of wastewater treatment corpus indicated that the use of passive voice is observed in about 31% of all tenses use in the corpus. Apparently, the authors write in active voice more frequently. However, the distribution of passives in the sections differ:

- in *Abstract* and *Conclusions* sections, the ratio of passive : active use is 1 : 3, which means that one passive phrase appears per three phrases in the active voice. This is in line with the general distribution, presented in Figure 3.

- in *M&M*, the passive voice is more frequent, and two sentences in passive are used over three sentences in active (ratio passive : active is 1 : 1.5). The peculiarity of this section is that the passive voice is fully appropriate. Wallwork [12, p. 221] stated "*you can ignore any expert advice that tells you that the passive should always be avoided*".

- in *R&D* section, three passive verbs appear over eight verbs in the active voice.

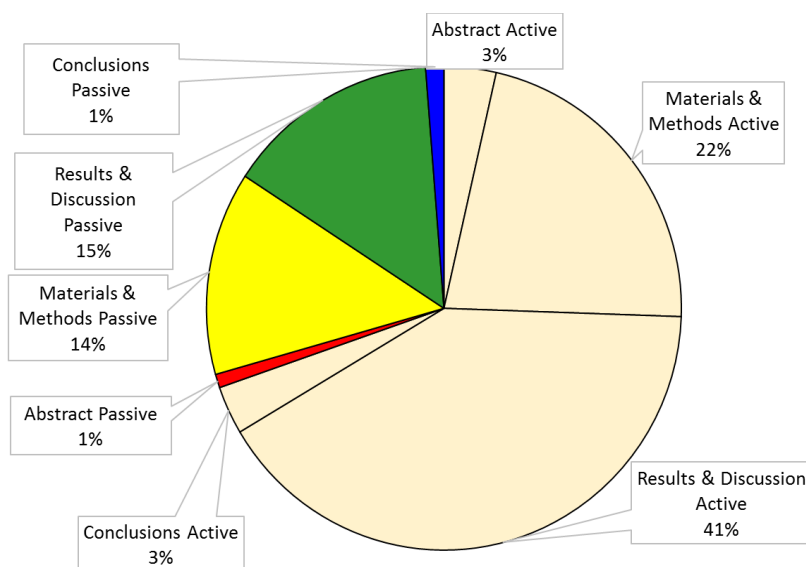


Figure 3. The use of passive voice in wastewater treatment corpus by sections (percentage from the total number of tenses use in the corpus).

The proportion of passive voice use is the same as was reported in Alvin's work [1, p. 8]: the corpus of scientific journals in Science and Medicine constituted of 30% of the studied clauses (units with the verbs). This observation shows a significant decrease in passive use compared to 42-56% found by the previous works cited in [1, p. 4]. Longman corpus [3, p. 158] claims that the passive verbs account for about 25% of all finite verbs, and the wastewater treatment corpus shows about 20% (value normalized to the same units as Longman corpus). Therefore, the recent trend in wastewater treatment articles indicates a shift towards active voice use.

A related grammatical issue is the use of personal pronouns. When using the active voice, the authors doubt if they can use personal pronouns. This issue is closely related to the passive voice, since the personal pronouns help to formulate the clause in a simple, concise and unambiguous way.

In the recent years, the scientists have shifted towards usage of personal pronouns. However, the use of personal pronouns in various sections differs in terms of scientific discourse. The use of personal pronouns in introduction section is applicable when authors

refer to other scientists' works or want to emphasize personal participation or responsibility:

*"They found that ferrate achieved the comparable..."* [23, p. 173].

*"When it comes to reducing the impact that we, as a society, have on our environment..."* [18, p. 226].

The use of personal pronouns in *M&M* is controversial, since the use of "we" raises several issues. The procedures in the section are performed by one person, who may not be even included to the authors [6, p. 69]. When the personal information is included (who performed the experiment), this adds insignificant details to the section, and this disrupts the structure of scientific discourse. In this case, the use of passive is more concise and appropriate. In *R&D*, *Conclusion* and *Abstract*, the use of personal pronouns describes the personal contribution of the authors to the research topic.

*"...we find that there was a statistically significant larger proportion of fipronil relative to degradation product"* [17, p. 884].

*"We hypothesize that effluent plume microbial populations will recover..."* [22, p. 291]

In this case, personal pronouns help to avoid excessive use of passive.

When the authors refer to the objects of research in plural, the use of "they" is also acceptable:

*"...they were calculated using the method..."* [20, p. 226].

*"pharmaceuticals... were selected because they are frequently detected..."* [16, p. 595].

Therefore, the authors can use personal pronouns to avoid excessive passive voice use and comply with the current trends in scientific writing.

The use of pronouns in wastewater treatment corpora indicates that the personal pronoun *we* is 0.05% of total word count in the corpus. The authors use *we* with the following verbs: *conclude/use/observe/identify*. The percentage of *we* in sections (of total pronouns in the section) is 24, 6, 9, and 8% in *Abstract*, *M&M*, *R&D*, *Conclusions*, respectively. The most common pronoun is *it*, with percentages 26, 23, 36, and 31% over sections. Hence, the use of personal pronouns is fully appropriate to avoid unnecessary passive voice.

The analysis of wastewater treatment corpus indicated that the use of passive voice is observed in about 31% of all tense use in the corpus. This is significantly less than the values found by the previous researchers. Therefore, the recent trend in wastewater treatment articles indicates a shift towards active voice use. The authors tend to use more personal pronouns to avoid excessive passive voice use, and this fully complies with current trends in scientific writing.

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## **ПАСИВНИЙ СТАН ДІЄСЛОВА В СУЧАСНИХ НАУКОВИХ СТАТТЯХ (НА ПРИКЛАДІ СТАТЕЙ З ОЧИЩЕННЯ СТИЧНИХ ВОД)**

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Стаття представляє корпусний аналіз вживання пасивного стану дієслова в сучасних наукових статтях, написаних англійською мовою. Використання пасиву в наукових статтях є спірним питанням, і сьогодні багато редакцій журналів вимагають вживання активного стану дієслова. Проте логіка наукового дискурсу в багатьох випадках вимагає пасивного стану дієслова. Відтак, метою статті є вивчення трендів у вживанні пасивного стану дієслова у сучасних наукових статтях. Матеріалом дослідження був корпус текстів, скомпільований з 50 наукових статей в галузі очищення стічних вод, опублікованих в 2016-2017 рр. Кожній лексемі було присвоєно маркер морфологічної розмітки, який генерували програмним кодом мови R і використовували для обчислення частоти часів, та дієслів у активній та пасивній формі. Пасивна форма вжита 31% від усіх

Частоти пасиву у секціях статей відрізняються: у анотації та висновках вживають одне дієслово в пасивній формі на три дієслова в активній; в розділі «Матеріали та методи» два дієслова в пасиві припадають на три дієслова в активному стані; у розділі «Результати та їх обговорення» автори вживають три пасивних дієслова на вісім дієслів в активі. Загалом у досліджуваному корпусі частота пасиву (20%) менша, ніж в корпусі Лонгман (25%), та порівняно з величинами, виявленими попередніми дослідниками. Розроблені рекомендації щодо вживання пасивного стану в наукових статтях, а також особливості використання особливих займенників для уникнення надлишкової кількості пасивних конструкцій.

*Ключові слова:* корпусна лінгвістика, академічне письмо, пасивний стан, частотний аналіз.