

A FREQUENCY DICTIONARY OF TERMS IN THE FIELD OF THERMOPLASTICS USED IN DESIGNING AND PRINTING VIRTUAL REALITY VIEWERS

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ABSTRACT

Plastic is described as a light and artificial substance that can be made into different shapes when it is soft. Plastic materials consist of a wide range of synthetic and semi-synthetic organic compounds that can be molded into solid objects. Many terms are used to understand properties and classifications of plastics such as thermoplastic and thermoset. A frequency dictionary of terms might enable students and teachers of all levels in Higher Education to build on their study of technic and specific concepts in the field of thermoplastics. Today, most children's toys are made of plastic such as toy blocks (e.g lego). Nowadays, thermoplastics are also used in designing and printing virtual reality viewers. For example, virtual reality glass might be counted in this category. The purpose of authors in this paper to create a frequency dictionary of terms in the field of thermoplastics used in designing and printing virtual reality viewers. For creating a frequency dictionary of terms in thermoplastics, three-stage is followed. In the first stage, raw frequency-based rank order and alphabetical order lists are presented. In the second stage, the frequency-based rank order is computed considering the roots of terms. In the third-stage, words commonly used in the field of thermoplastics are presented. A frequency dictionary of terms in thermoplastics may serve the needs of students and teachers in understanding the core concepts of thermoplastics since it gains a terminology unit.

Keywords: *plastics, thermoplastics, frequency, terms, virtual reality*

1. INTRODUCTION

A language is described as a type of communication used by the people of a particular country such as English, Spanish, Japanese and Turkish. However, languages are not limited to the people of a particular country. The words used by people in a particular job and instructions to write computer programs is also considered as a language such as the use of words in education, health and entertainment and programming languages such as MATLAB, C# and Java. Nowadays, frequency dictionary of words belonging to any languages such as English and Turkish are used to enable their learners and teachers of all levels to build on their study or work of languages in an efficient and engaging way (Aksan, Aksan, Mersinli, & Demirhan, 2017). The top 3000 or 5000 most frequently used words are generally listed in studies on frequency dictionary of languages. Davies (2005) find that the top 1000 lexemes in English account for 80% of all tokens in a given text. Today, the words used to refer to a particular thing especially in a technical or scientific subject form an important part of any discipline and named terms. Like the connection between language and identity (Karaman, 2014), a terminology unit contributes to the identity of academicians belonging to a particular discipline such as thermoplastics. Plastic is described as a light and artificial substance that can be made into different shapes when it is soft. Plastic materials consist of a wide range of synthetic and semi-synthetic organic compounds that can be molded into solid objects. Today, most children's toys are made of plastic such as toy blocks (e.g lego). Nowadays, thermoplastics are also used in designing and printing virtual reality viewers. For example, virtual reality glass might be counted in this category. Many terms are used to understand properties and classifications of plastics such as thermoplastic and thermoset.

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A frequency dictionary of terms might enable students and teachers of all levels in higher education to build on their study of technic and specific concepts in the field of thermoplastics. The authors of this paper create a frequency dictionary of terms in the field of thermoplastics in English and Turkish with the purpose of helping individuals working on thermoplastics for designing and realizing virtual reality viewers using 3-D printers. The research questions of the study have been formulated as:

- Firstly, what is critical to develop an algorithm to calculate the frequency of words in text regardless of its languages? By this this question, it is aimed to understand what characters should be removed from a text.
- Secondly, what inflectional suffixes should be removed from a text to calculate the frequency of core vocabulary in the discipline of thermoplastics? By this question, it is aimed to understand what suffixes should be removed from words with the purpose of preventing duplications in the frequency dictionary of terms in discipline of thermoplastics (e.g. polymer & polymers)
- Firstly, what words are commonly used in the discipline of thermoplastics in both English and Turkish? By this question, it is aimed to create a frequency dictionary of terms in the field of thermoplastics. The creation of a frequency dictionary of terms in thermoplastics is important for its learners and teachers, because it addresses the issue of core vocabulary (Davies, 2005).

2. METHODOLOGY

There are several studies on the dictionary of terms for disciplines. However, none has been carried out for thermoplastics in either Turkish or English. Most likely, the reasons for this is that thermoplastics has not drawn the most people's attention until the prevalence of 3-D printers in the market. The difficulty of processing Turkish and English texts for frequency count should be also considered for the clarification of the lack of studies on the frequency dictionary of thermoplastics. The selection of raw materials upon which to base such a study is essential to carry out a vocabulary coverage for thermoplastics. There are many studies related to plastics such as "Plastics Materials" by J. A. Brydson (1999) whereas they are not directly related to thermoplastics because they cover plastics in a broad manner. The three-study on thermoplastics in English and nine-study in Turkish are selected to implement a frequency analysis as illustrated in Table 1.

Table 1. Source List

No	Lang.	No. of Page	Title	Editors
1	English	638	Handbook of Condensation Thermoplastic Elastomer	Stoyko Fakirov
2	English	425	Handbook of Thermoplastic Elastomers	Jiri George Drobny
3	English	156	Thermoplastic – Composite Materials	Adel Zaki El-Sonbati
4	Turkish	311	Farklı Lihnoselülozik ve Termoplastik Madde...	Ayfer Dönmez Çavdar
5	Turkish	162	Bazı Termoplastik Kompozit Malzemelerin Mek...	Emre Kurtuluş
6	Turkish	89	Termoplastik Malzemelerin Birleştirme İşlemleri ...	İsmail Açar
7	Turkish	122	Farklı Dolgu Maddelerinin Termoplastik Elastome...	Nursel Karakaya
8	Turkish	66	Bor İçeren Termoplastik Poliüretan Kompozitler	Selma Çakır
9	Turkish	111	Termoplastik Polyester Elastomerlerin Sentezi ve ...	Şükran Paça
10	Turkish	74	Farklı Yapıya Sahip Kil Mineralleri ile Tpu (Term...	Metehan Atagür
11	Turkish	206	Termoplastik Poliüretan Sentezi ve Kompozit ...	Zerrin Altıntaş
12	Turkish	94	Karbon Elyaf Takviyeli Termoplastik Karmala...	N. G. Karşlı Yılmaz

3. FINDINGS

3.1. Algorithm for Basic Frequency Analysis

The frequency dictionary of words in thermoplastics is considered as the number of times a word happens in a paragraph, text or even language itself. However, at the time of this writing, there is no corpus of thermoplastics in either English or Turkish. Therefore, it is critical to develop an algorithm to calculate the frequency of words in given texts in both English and Turkish. However, a text given in English or Turkish might consist of many unwanted characters such as html tags, html special characters, numbers, punctuation and so on. A flow chart as illustrated in Figure 1 might work to carry out a coverage on a text in English or Turkish.

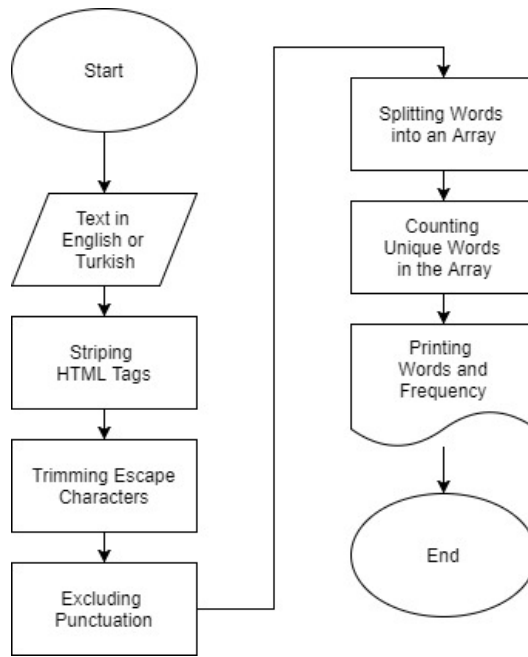


Figure 1. An Flow Chart on a Basic Frequency Analysis

3.2. Algorithm for Core Vocabulary Analysis

A word in a text regardless of whether it is written in English or Turkish may include one or more inflectional suffixes. For example, inflectional suffixes can be counted as plurality (e.g. -s as in horses), possession (e.g. -s as in Mary’s), past tense (e.g. -ed as in walked), progressive tense (e.g. -ing as in reading), comparative (e.g. -er as in brighter), superlative (e.g. -est as in brightest) and personal singularity (e.g. -s as in sleeps) in English. On the other hand, inflectional suffixes in Turkish seem to be more wider and more complex such as plurality (e.g. -ler as in evler), possessive (e.g. -iniz as in eviniz), positional cases (e.g. -e as in eve), relative (e.g. ki, evdeki). Therefore, it is important to exclude inflectional suffixes from words in English and Turkish to carry out a coverage analysis of words in a given text. However, Turkish words can have more than one affixes at the same time whereas it is not true for English words. On the other hand, there is a strict rule in the order of inflectional affixes in words written in Turkish (e.g. *masalarımızdaki* & *evimin*) as illustrated in Figure 2 and 3 for nouns and verbs.

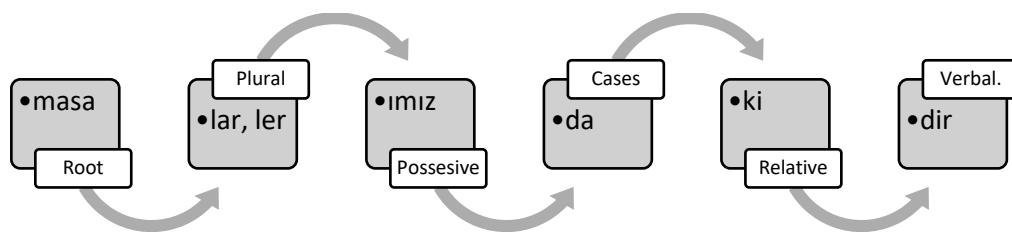


Figure 2. The order of Turkish affixes in Nouns

As illustrated in Figure 2, inflectional affixes should be suffixed into a Turkish word in this order: plural, possessive, positional cases, relative and verbalizer in case the root is a noun. However, if the word is a verb, the order of the inflectional affixes should be modal, negation particle, 1. tense, interrogative particle, 2. tense, and possessive suffixes.

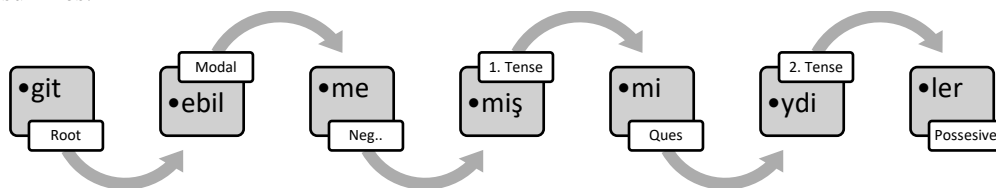


Figure 3. The order of Turkish affixes in Verbs

On the other hand, there is not a rule for the order of inflectional suffixes in English words since an English word may have only one inflectional suffix at the same time. On the other hand, there is an exception that departs from the rule for both English and Turkish. For example, the word “araba” in Turkish has no positional suffixes. However, since it ends with the “a”, we need to ensure that our algorithm understand that the word “araba” does not have an accusative case (i.e. “a”, “e”, “i”, “ı”) but a nominative case. For these reasons, it seems to be essential to create a database for notifying algorithm concerning exceptions especially associated with positional cases.

3.3. Commonly Used Words in the Field of

The authors of this paper aim at creating a frequency dictionary of terms in the field of thermoplastics for helping individuals for designing and realizing virtual reality viewers using 3-D printers. Our findings are given in two sections. In the first section, a raw frequency-based rank order and alphabetical order lists are presented. In the second section, the frequency-based rank order is computed considering the roots of terms. These sections are implemented for both Turkish and English.

3.3.1. Initialized Frequency Findings

Table 2 illustrates the initial frequency of sources in English and Turkish together and separately. As illustrated, 414593 words obtained from three sources in English and 176806 words from nine sources in Turkish. However, the number of unique words in all English sources is calculated as 17040 but 20575 in Turkish. This arises from the fact that Turkish is an agglutinative language. Moreover, the number of words that used only once in Turkish studies (e.g. 10737) doubles the English (e.g. 6806). The words with 1-frequency are generally private names, variables and so on for both English and Turkish.

Table 2. Initial Frequency

Source	Lang.	Pages	No. of Words	Frequency					No. of Unique
				1	2-9	10-99	100-999	1000+	
1	En.	489	198682	4399	4223	1874	272	18	10786
2	En.	425	167608	3765	3777	1713	236	15	9506
3	En.	156	48303	2274	2292	638	69	3	5276
1-3	En	1070	414593	6806	6506	3129	556	43	17040
4	Tr.	311	51772	4381	2535	472	91	1	7480
5	Tr.	162	20303	2079	1432	281	25	0	3817
6	Tr.	89	13130	2525	1483	186	6	0	4200
7	Tr.	74	18070	1760	1394	258	21	0	3433
8	Tr.	94	7254	1765	898	91	2	0	2756
9	Tr.	122	13146	1974	1348	214	5	0	3541
10	Tr.	66	11198	2083	1128	166	5	0	3382
11	Tr.	111	28054	3448	2153	447	26	0	6074
12	Tr.	206	14063	1702	1019	211	14	0	2946
4-12	Tr.	1235	176990	10737	7464	2084	279	8	20575

Table 3 illustrates the number of the words used more than 1000. As illustrated, it was calculated as 43 in English and 8 in Turkish sources. The majority of these words are prepositions (e.g. “of”, “in”, “to”, “with” & “at” in English and “ile”), conjunctions (e.g. “and”, “or” & “so” in English and “ve” in Turkish), demonstrative adjectives (e.g. “this” & “that” in English and “bu” in Turkish), axillary verbs (e.g.s & are) and variables (e.g. “C” in English and Turkish).

However, as illustrated in Table 3, six words in English (i.e. elastomers, phase, polymer, property, temperature, thermoplastic) and used and one word in Turkish (i.e. termoplastik) are considered as a term used in the discipline of thermoplastics. Moreover, as illustrated in Table 3, the words “elastomers”, “properties” and “used” have inflectional suffixes namely plurality and past tense.

Table 3. The Turkish and English Words with more than 1000 Frequency

No	Word	Lang.	No	Word	Lang.	No	Word	Lang.
1	a	En.	18	figure	En.	35	p	En.
2	an	En.	19	for	En.	36	phase	En.
3	and	En.	20	from	En.	37	polymer	En.
4	are	En.	21	g	En.	38	properties	En.
5	as	En.	22	h	En.	39	r	En.
6	at	En.	23	ile	Tr.	40	s	En.
7	b	En.	24	in	En.	41	sekil	Tr.
8	be	En.	25	is	En.	42	temperature	En.
9	bir	Tr.	26	it	En.	43	termoplastik	Tr.
10	bu	Tr.	27	j	En.	44	that	En.
11	by	En.	28	m	En.	45	the	En.
12	c	Tr.	29	n	En.	46	thermoplastic	En.
13	c	En.	30	o	En.	47	this	En.
14	can	En.	31	of	En.	48	to	En.
15	d	En.	32	olarak	Tr.	49	used	En.
16	e	En.	33	on	En.	50	ve	Tr.
17	elastomers	En.	34	or	En.	51	with	En.

3.3.2. Finalized Frequency Findings

The frequency-based rank order of words was also computed considering terms without inflectional suffixes as illustrated in Table 4 for English and Turkish sources with more than 500 frequencies. As illustrated, table consists of Turkish and English words together. Some words in both languages could be matched (e.g. figure-sekil, table-tablo, property-özellik and polymer-polimer).

Table 4. The Turkish and English Words with more than 500 Frequency without Inflectional Suffixes

No	Word	Lang.	No	Word	Lang.	No	Word	Lang.
1	application	En.	19	levha	Tr.	37	resistance	En.
2	aşınma	Tr.	20	low	En.	38	rubber	En.
3	base	En.	21	material	En.	39	segment	En.
4	blend	En.	22	mechanical	En.	40	şekil	Tr.
5	block	En.	23	melt	En.	41	soft	En.
6	çekme	Tr.	24	mold	En.	42	strength	En.
7	chemical	En.	25	molecular	En.	43	structure	En.
8	composite	En.	26	olarak	Tr.	44	table	En.
9	copolymer	En.	27	oran	Tr.	45	tablo	Tr.
10	different	En.	28	özellik	Tr.	46	temperature	En.
11	elastomer	En.	29	phase	En.	47	termoplastik	Tr.
12	elyaf	Tr.	30	polimer	Tr.	48	thermal	En.
13	figure	En.	31	poly	En.	49	thermoplastic	En.
14	hard	En.	32	polym	En.	50	üretilen	Tr.
15	high	En.	33	polymer	En.	51	use	En.
16	injection	En.	34	polyurethane	En.	52	yüksek	Tr.
17	karbon	Tr.	35	process	En.			
18	kullanım	Tr.	36	property	En.			

4. CONCLUSION

The author of this study aimed at creating a frequency dictionary of terms in the field of thermoplastics in both English and Turkish for helping individuals design and print virtual reality viewers, toy blocks, cases, and so on using 3-D printers. It is expected with our frequency dictionary of terms that people will recognize that core vocabulary used in the field of thermoplastics. The research findings of our study could be emphasized as follows: Firstly, we found that it is critical to remove unwanted characters from a text regardless of its languages such as English or Turkish. Our findings indicate that html tags, html special characters, numbers and especially punctuation plays a critical role at the beginning. However, numbers at the beginning, middle and end of a word should not be removed because they may become a part of the core vocabulary in English (e.g. PU105) and Turkish (e.g. Ç26).

Moreover, we also found that a case-sensitive algorithm also plays a critical role in the calculating the frequency dictionary of terms in thermoplastics because abbreviations (e.g. ÇFA, MDFZT & TPU) are frequently used texts relevant to thermoplastics. Secondly, our findings indicate that inflectional suffixes should be removed from words regardless of the language of a given text because they increase the number of words in the frequency dictionary of terms without pointing core vocabulary. Our findings reveal that a word may have several types of inflectional suffix related to plurality, possession and past and progressive tense and so on. Moreover, the order of inflectional suffixes should be considered Turkish languages whereas it is not a case for English languages Thirdly, we presented commonly used words in the discipline of thermoplastics in both English and Turkish. It is expected that our findings will learners and teachers in the field of thermoplastics because our frequency dictionary of terms addresses the issue of core vocabulary. Moreover, our findings may be a guidance for individuals interested in frequency dictionary of terms in any fields.

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