An Indexing System and Code For Polymers

PANOS KOKOROPOULOS and SEBASTIAN V. KANAKKANATT
Center for Information Services, The University of Akron, Akron, Ohio

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The Indexing system for polymer science information retrieval developed at the Center for Information Services, University of Akron, is presented. The use of a simplified fragmentation system reduces considerably the number of indexing terms and contributes greatly to the consistency of indexing. Numerical as well as alphabetic suffixes distinguish one family of terms from another and serve to give highlights of their function. Classification of the terms existing in the indexing system under five levels of hierarchies facilitates retrieval at any level from the specific to the highest generic. Functions and properties are designated by "Index also terms," while synonyms and fragmentation of exceptional terms are handled through "directive terms." The system described is a working system, and it is being continuously tested and evaluated by extensive use and user feedback.

The language of Polymer Chemistry is, no doubt, one of the most complicated and least systematized scientific languages. The continuous and rapid addition of new polymers and the lack of a general nomenclature scheme tend to make the polymer vocabulary a rather ineffective means of communication.

Although such ineffectiveness may not appear to affect the polymer chemist, it is a major obstacle for the information analyst or indexer.

A well-structured controlled and comprehensive indexing system is a must for the effective processing of information for storage and subsequently for retrieval.

With this in mind, the Center for Information Services of The University of Akron has developed an indexing vocabulary and coding system for high polymers.

The indexing terminology discussed in the present paper by no means represents an attempt to develop a new or to systematize the existing polymer nomenclature. It is rather a set of conventions and rules for increasing indexing consistency and search capabilities. Used in the indexing of over 18,000 articles and in the formulation of over 2400 search questions, it has proved to be a powerful tool in the hands of the information analyst.

Extensive user feedback confirmed the adequacy of the system as an indexing and searching device.

PRINCIPLES AND METHODS

The need for a comprehensive indexing system encompassing a large number of topics and concepts led to the establishment of three main categories of terms:

a. *Materials or Chemical Terms:* Polymers, monomers, chemicals used in the preparation and processing of polymers, etc.

b. *Concepts or Non-Chemical Terms:* Properties, Processes, Functions, End Product Uses, etc.

c. *Descriptive or Qualifying Terms:* Rubbers (Natural and Synthetic), Plastics, Thermoplastics, and Thermosets, Synthetic Fibers, Natural Fibers, End Products, Tires, Adhesives, Coatings, etc.

The main effort was concentrated in the development of a systematic indexing vocabulary for polymers based on available nomenclature schemes, such as IUPAC and Chemical Abstracts, as well as on common or trivial names.[2,3,4]

The basic principle was to represent a given polymer by a combination of chemical entities and moieties (fragments), the names of which are much simpler than that of the polymer.

A consequence of this principle was that a relatively small number of such fragments could be used in various combinations to represent a much larger number of polymers. In fact, as of last count, about 6000 fragments have been used to index over 23,000 polymeric materials.

The method followed to accomplish this task was an extension of the Fragmentation System for Indexing Organic Compounds developed by one of the authors[5,7] (Appendix A). According to this fragmentation system, any organic compound consists of a relatively simple basic structure and a number of substituent groups directly or indirectly connected with the basic structure.

In the case of polymers, it was found that in the majority of cases the repeat unit could be used as the basic structure, e.g.:

Poly*ethylene*
Polytetrafluoro*ethylene*
Poly*acrylamide*
Poly*propylene*, 1-Chloro, 2-phenyl
Poly*ethylene*-co-*propylene*
Poly*styrene*-co-*butadiene*
Acrylonitrile-Butadiene-Styrene Terpolymer

It was also found that in most cases, the repeat unit is the part of the monomeric material that takes part in the polymerization, e.g.:

Ethylene	Polyethylene
Acrylonitrile	Polyacrylonitrile
Butadiene	Polylentadiene
Styrene	Polystyrene

It was evident that a basic structure with the appropriate indicator could be used to indicate a monomer,

a homopolymer, a copolymer etc. Thus:

Styrene (0) was used to denote styrene monomer.
Styrene (1) was used to denote polystyrene.
Styrene (2) was used to denote any copolymer of styrene.
Styrene (3) was used to denote any terpolymer of styrene.
Styrene (4) was used to denote any quaterpolymer of styrene.

Similarly:

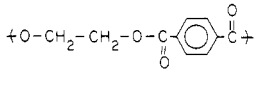
Butadiene (0) was used to denote butadiene nomomer.
Butadiene (1) was used to denote polybutadiene.
Butadiene (2) was used to denote any copolymer of butadiene.
Butadiene (3) was used to denote any terpolymer of butadiene.
Butadiene (4) was used to denote any quaterpolymer of butadiene.

In this arrangement the term copolymer was used to denote only bipolymers. The significance of such an arrangement is illustrated in the following examples:

Polystyrene-co-butadiene, a copolymer of styrene and butadiene, may be called either a copolymer of styrene or a copolymer of butadiene. Both are broader terms than the specific Polystyrene-co-butadiene. Actually when we say copolymer of styrene we include Polystyrene-co-butadiene, Polystyrene-co-ethylene, Polystyrene-co-vinyl acetate, etc.—the whole spectrum of styrene-containing copolymers. This was achieved by the term styrene (2). On the other hand in a system of naming the copolymers by their components, any specific copolymer was pinpointed by using the two terms, one for each part, e.g.:

Styrene (2)
and
Butadiene (2)
} were used to denote Polystyrene-co-butadiene

In a condensation polymer such as Poly(ethylene terephthalate), the similarity of the repeat unit



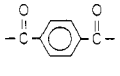
with the repeat unit of an alternating copolymer led to the following indexing:

Ethylene glycol (2)
and
Terepthalate (2)
and
Condensation Polymers

Here the terms Ethylene glycol (2) and Terephthalate (2) were used to denote the "source" radicals

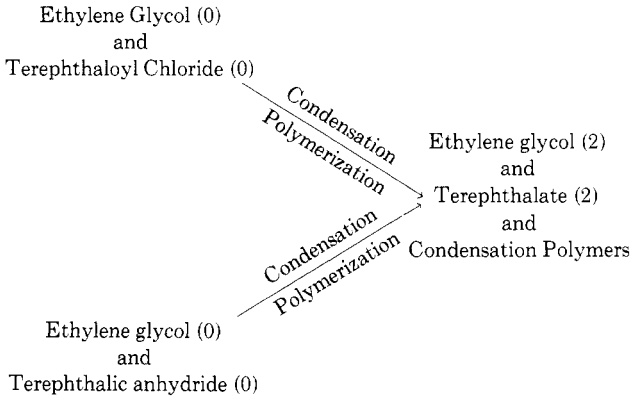
$$-O-CH_2-CH_2-O-$$

and



respectively.

Poly(ethylene terephthalate) was always indexed as indicated above, no matter what the monomeric "source" materials were. Thus a polymerization reaction resulting in Poly(ethylene terephthalate) would be designated as follows:



Throughout the preceeding discussion, the basic structures were defined as simple unsubstituted chemical entities. To preserve this concept, substituted materials were further fragmented to the basic structures and the substituent groups, elements, or radicals. Suffixes, (s) and (side), were used with the substituent groups to indicate substitution on the monomer and polymer, respectively.

Propene, 1-chloro, 2-Phenyl was indexed as
Propene (0)
and
1-Chloro (s)
and
2-Phenyl (s)
Polypropylene, 1-chloro, 2-Phenyl was indexed as
Propene (1)
and
1-Chloro (side)
and
2-Phenyl (side)
Polymethylmethacrylate was indexed as
Methacrylate (1)
and
Methyl ester (side)

STRUCTURE AND CONTROL

The method described above provided the necessary systematic approach and adequate consistency in handling chemical terms for indexing purposes; however, by having a systematized vocabulary, only the preliminary task is achieved. The fragmentation approach helps mainly to decrease the number of terms and increases vocabulary control. But maximum flexibility and efficiency in the use of an indexing system is achieved only when the appropriate generic relationships among the indexing terms have been established. To meet this objective, a classification scheme for the indexing terms was developed. Usually the criterion of classification of all the families of chemical materials is the chemical structure of the material (or the fragment). Here, it was necessary to define the difference between three different types of terms:

1. A generic name given to a group of materials which have a common feature in their structure, e.g., Vinyl Polymers.

This term gives information regarding the part of the structure that is common; but it does not describe any property or function directly.

2. A generic name given to a group of materials which have one function or a mode of reaction in common, e.g.:

i. Catalysts
ii. Addition Polymers

These terms do not give any indication as to what the main structure is or what the main properties are. (Catalytic activity may be called a property for argument's sake, but it is more often understood as a function rather than a property.)

3. A generic name given to a group of materials which have one property in common, but does not give any insight into its structure or function, e.g.:

PLASTICS AND RESINS

This term conveys the fact that the materials is plastic or resinous in nature and the flow property is at once evident from the name. These three types of terms led to the establishment of the classification scheme and defined the structure of the indexing system.

The indexing terms were first classified into groups having the same structural feature, i.e.,

Vinyl Chloride (1) Acrylamide (1) Styrene (1)	Vinyl Polymers	
Polymers from omega-aminoacid Polymers from one diacid and one diamine Copolymers from one diacid and two diamines		Polyamides
Cyclopropyl (side) Cyclobutyl (side) Cycloalkenyl (side)	Alicyclic (side)	

The groups or families of materials were subsequently classified into broader groups which had either a common function or a common mode of reaction or formation, i.e.,

Vinyl Polymers Alkene Polymers Alkyne Polymers	Addition Polymers
Polyamides Polyesters Polyurethanes	Condensation Polymers
Palladium (cat) Titanium Tetrachloride (cat) Aluminum Triethyl (cat) Lithium Aluminum Hydride (cat)	Catalysts

Typical examples of the structure of the indexing vocabulary are summarized in Figures 1 and 2.

Thus, for each family of terms, a hierarchy was established showing the structural relationship of the materials described by the terms. Almost all the terms resulting from the fragmentation process were placed in only one category. Relatively few terms were found that could be placed in more than one category, that is, having more than one possible higher generic. Polyfunctional

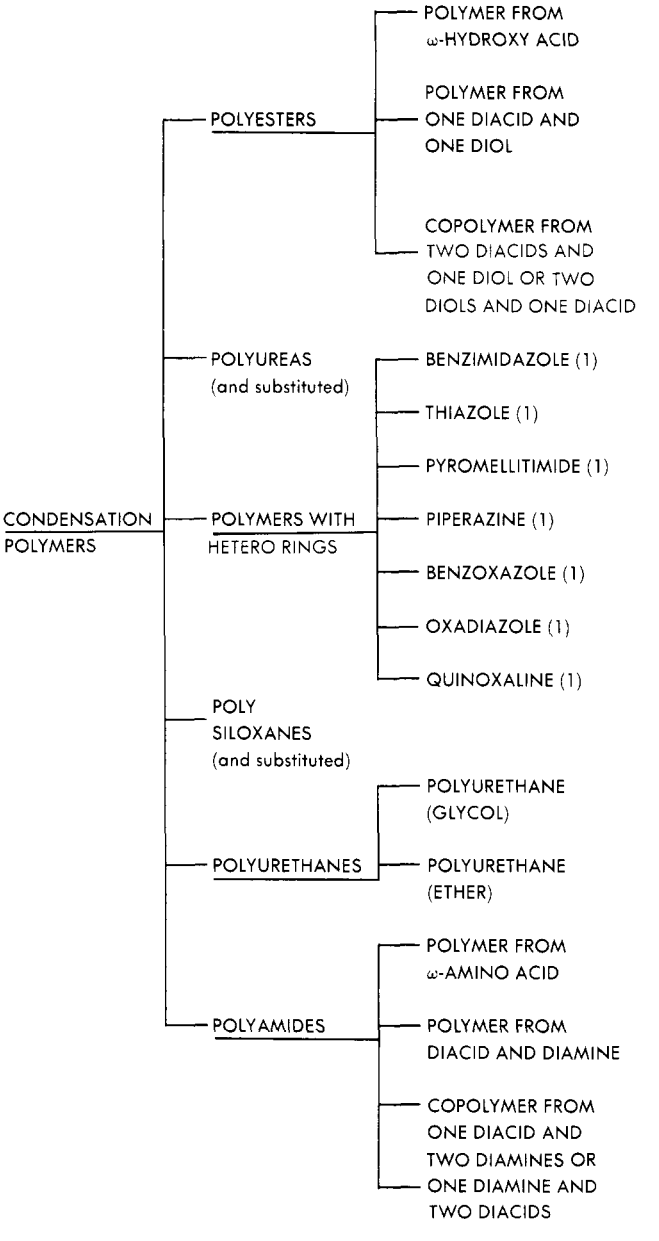


Figure 1. Hierarchic classification of indexing terms for condensation polymers

monomers with nonidentical functional groups serve as good examples. This problem was solved by the use of a qualifying term called "*index also term.*" This index also term described either the alternative higher generic or a condition or property, e.g.:

Acrylate (1) and Vinyl acetate (1) were classified as vinyl polymers, but they are also "Ester containing polymers." Thus the "Index also term" "Ester containing polymers" was used to indicate the alternative higher generic.

In the case of methyl vinyl ether (1), the "Index also term," "Ether containing polymers," was used to indicate the alternative higher generic.

By restricting the meaning of the word "containing" only to mean "contained in the side chain or as the side group" it has been possible to differentiate polymers

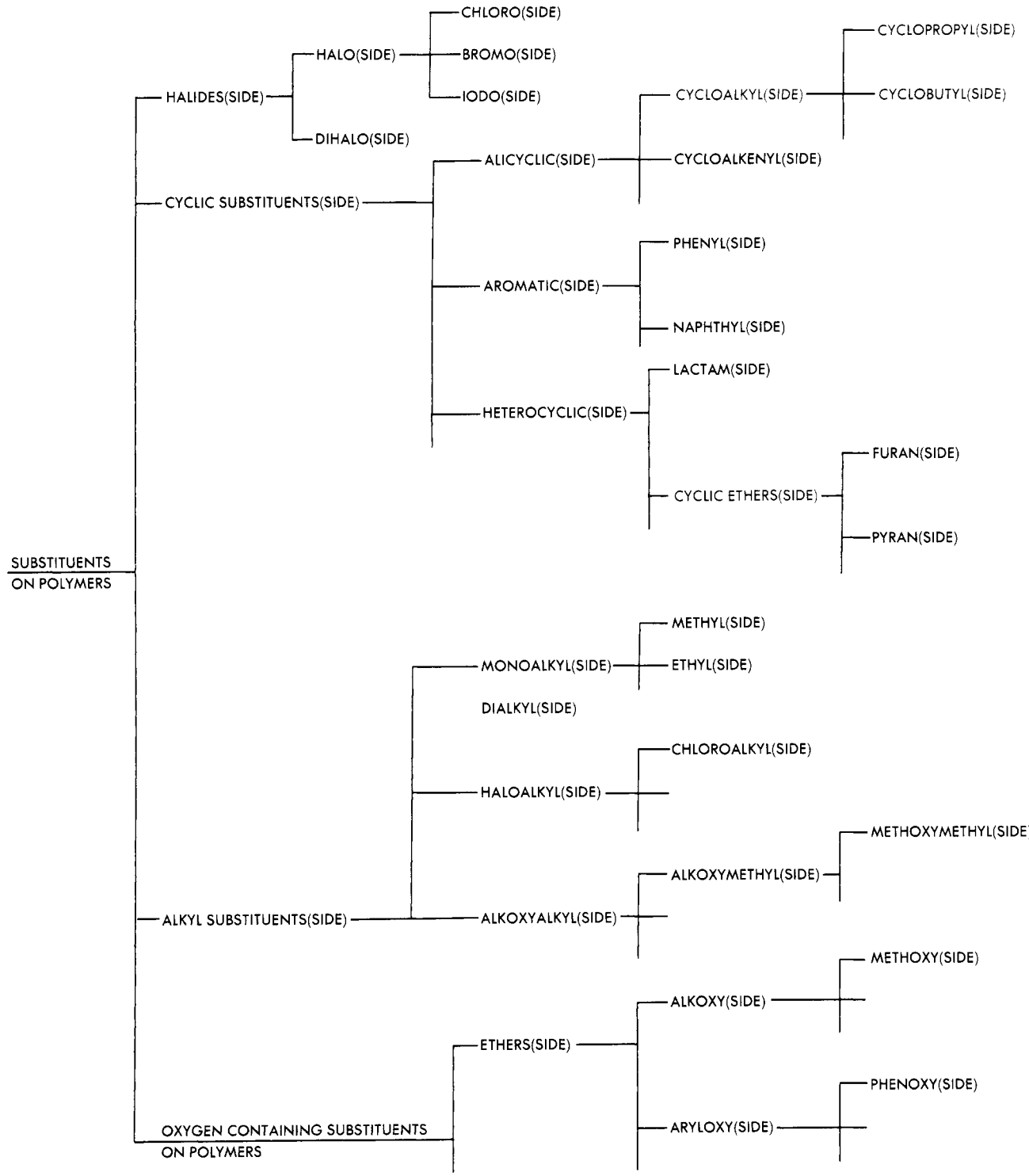


Figure 2. Hierarchic classification of indexing terms for substituents on polymers

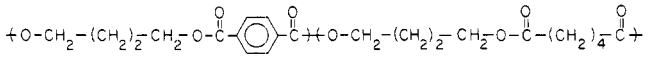
with a characteristic group in the main chain from those having the same characteristic group in the side chain, e.g., Oxyethylene (1), a polyether and methyl vinyl either (1), a vinyl polymer.

In the case of styrene-butadiene copolymer the per cent content of styrene determines whether this copolymer is a rubber or a plastic. A terminology of materials cannot include the property or per cent composition. SBR means styrene-butadiene rubber, only because the additional term rubber is introduced in the name. What actually is meant is this: A Polystyrene-co-butadiene sample which is rubbery at ambient temperature. The system handled this case as follows:

styrene (2)
and
butadiene (2)
and
synthetic rubber

Here the "index also term" "synthetic rubber" was used in the place of rubber. The word "rubber" implied elasticity at ambient temperature. This was included in the word synthetic rubber and something more, that the material was "synthetic" not "natural" rubber.

In condensation polymers, unlike the addition polymers, the suffix (2) was not always conclusive indication that the material was a copolymer. For example, the condensation copolymer



provided upon fragmentation three distinct chemical species, but only two repeat units. This resulted in the following indexing:

Terephthalate (3)
and
1,4-Butanediol (3)
and
Adipate (3)
and
Copolymer
and
Condensation Polymerization

Here the suffix (3) was used to indicate the number of chemical species, while the "index also term" copolymer was used to indicate the number of repeat units, in other words, to indicate that the material was a copolymer.

Whenever the use of an "index also term" was not sufficient to indicate the function of a term, special indicative suffixes were used. A partial list of such suffixes and their meanings follows:

..... (Cat)	Catalyst
..... (Stablr)	Stabilizer
..... (Plast)	Plasticizer
..... (Vul ag)	Vulcanizing agent
..... (Antiox)	Antioxidant
..... (Intr)	Initiator
..... (Emulr)	Emulsifier
..... (Pig)	Pigment
..... (Actv)	Activator

These suffixes proved to be very useful especially when the same chemical compound was used for different functions, e.g.,

Vinyl toluene (o)	and vinyl toluene (Vul ag)
Zinc oxide (Pig)	and zinc oxide (Actv) and
Zinc oxide (Cat)	
Sodium chloride (Cat)	and sodium chloride (Stablr)
Sulfur (Intr)	and sulfur (Vul ag)

Finally, a set of "directive terms" was established to:

a. Direct the indexer to use accepted terms, e.g.,

Adipic acid ester (2)	use: Adipate (2)
Butylene (1)	use: Butene (1)

and

b. Indicate the accepted fragmentation, e.g.,

Cinnamic acid (0)	use: Acrylic Acid (0) 3-Phenyl (s)
1,5-Hexanediol (2)	use: 1,5-Pentanediol (2) Methyl (side)

CODE SYSTEM

Each term in the indexing system was assigned a unique code number. This number was seven digits long and divided into five fields as follows:

$P_1P_2\,P_3\,P_4\,P_5\,P_6P_7$ where $0 \leqq P_k \leqq 9$

Digits	Designation
P_1P_2	Highest generic class
P_3	
P_4	
P_5	
P_6P_7	Lowest generic class

Thus:

01.0.0.0.00	Addition polymers
02.0.0.0.00	Condensation polymers
03.0.0.0.00	Monomers
06.0.0.0.00	Natural polymers
12.0.0.0.00	Initiators
13.0.0.0.00	Inhibitors
21.0.0.0.00	Catalysts
24.0.0.0.00	Accelerators
47.0.0.0.00	Polymerization

The code number specified the position of the term in the hierarchy of the system within a given family.

01.0.0.0.00	Addition polymers
01.1.0.0.00	Vinyl polymers
01.1.3.0.00	Aromatic polymers
01.1.3.1.00	Styrene polymers
01.1.3.1.01	Styrene (1)

The hierarchical level of a term was indicated by the first non-zero field from the right.

No field left of this may be zero, that is when $P_k = 0$, then P_{k+1}, P_{k+2}, etc. must be zero except in the highest and lowest generic levels.

Thus code numbers such as:

00.1.1.2.01
02.0.1.3.05
02.1.0.2.15
03.1.3.0.08

were not allowed.

Since the over-all storage and retrieval system was based on an inverted file, the code system was used for hierarchical reference generation. A posting on one term generated a posting on its next more general term.

For example a posting on a term designated by the code 02.3.1.1.04 generated a posting on 02.3.1.1.00, then on 02.3.1.0.00 up to 02.0.0.0.00 which was the highest generic level.

This arrangement permitted searching of the files at any level of hierarchy. Search for code number 02.3.1.0.00 would retrieve information pertaining not only to the term 02.3.1.0.00, but to all terms for which the last two levels of hierarchy were different than zero. This is illustrated in Figure 3.

A sample of the complete structure of the indexing system described is given in Appendix B.

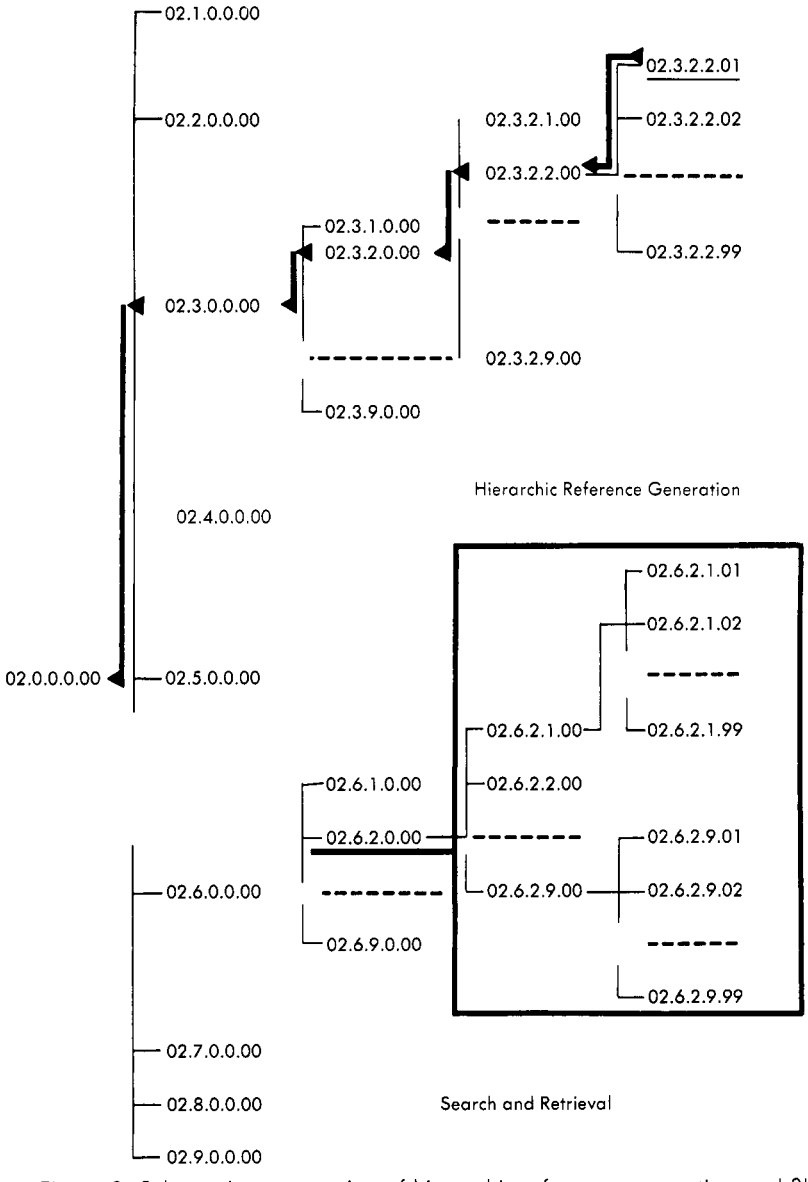


Figure 3. Schematic presentation of hierarchic reference generation and file search

APPENDIX A
A FRAGMENTATION SYSTEM FOR HANDLING ORGANIC COMPOUNDS[5]

The fragmentation system described is based on the concept that each organic compound consists of a number of discrete fragments connected in a given order. Since many compounds can be constructed from the same fragments by changing the order in which they are connected, a relatively small number of fragments is sufficient to describe a large number of compounds.

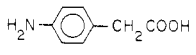
The fragments of an organic compound can be either complete compounds which are referred to as "Basic Structures" or atoms, and functional groups or radicals called "Substituents." The fragments are named according to the IUPAC Systematic Nomenclature with few exceptions where common or trivial names are used.

The vocabulary of the present system consists of fragments as described with a slight modification; each fragment is assigned a two consecutive-digit number called a "U. D. Connector" which specifies the fragment as a basic structure or indicates the position of the fragment as a substituent group in a structure.

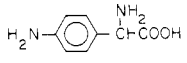
Basic Structures. According to the IUPAC Systematic Nomenclature, each organic compound is named after a basic structure and one or more substituents—i.e., nitro*benzene*, ethylpropyl*amine*, and amino-*acetic acid*. In most cases, the basic structures are either simple compounds, hydrocarbons (aliphatic and aromatic), alcohols, aldehydes, acids, simple heterocyclic compounds, or a functional group, such as amine, ketone, or sulfone—i.e., chloro*toluene*, phenylpropyl*ketone*, amino*phenol*. In some cases, common or trivial names are used as basic structures. Common names are retained (1) when they are widely used (aniline, acetone, phenol, toluene, acetic acid) and (2) when fragmentation into simpler systematic terms would create a very large number of postings on a given term. Thus, the terms aniline, phenol, and toluene are used instead of benzene/amino, benzene/hydroxy, and benzene/methyl. However, alpha-substituted toluenes are fragmented.

The selection of the basic structure of an organic compound is dictated by its systematic name—i.e., 4-*ethyl*-2-methyl *pyridine*, butyl methyl *ketone*, fluoro*benzene*. When functional groups are present in a molecule, the one highest in the order of precedence determines the basic structure—i.e., *o*-amino*benzoic acid*, *N,N*-diethylamino*benzaldehyde*. The order of precedence of functions given by *Chemical Abstracts*[1] is followed.

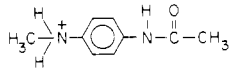
The U. D. Connectors. The U. D. Connectors are sets of two consecutive digits which indicate the "connection" of a substituent with a basic structure or another substituent. All basic structures have the connector 11, while unsubstituted compounds are designated with the connector 10. Thus acetic acid 11 indicates that one or more hydrogens have been replaced by other groups. A substituent on a basic structure is designated by the connector 12. Further substitution is indicated by connectors 23, 34, 45, etc.



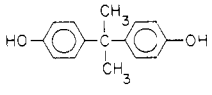
ACETIC ACID 11
PHENYL 12
AMINO 23



ACETIC ACID 11
PHENYL 12
AMINO 12
AMINO 23



AMMONIUM SALT 11
PHENYL 12
METHYL 12
AMINO 23
N-ACETYL 34



PHENOL 11
METHYLENE 12
METHYL 23
BIS

The use of connectors enables the searcher to search either for one specific compound or for a class of compounds. For example, searching under the terms AMINE P 11, will yield all information available on primary amines. On the other hand, searching under AMINE P 11/PROPYL 12 will yield all information available on primary propylamine. Thus the desirable degree of generality of specificity in searching is achieved when the connectors are used.

APPENDIX B

INDEXING TERMINOLOGY AND CODE SYSTEM

01.000.00 ADDITION POLYMERS

01.100.00 VINYL POLYMERS
01.110.00 ACRYLIC POLYMERS
01.111.00 ACRYLAMIDE POLYMERS
Synonyms: Propenamide Polymers, Propenoic Acid Amide Polymers
Index Also: Amide Containing Polymers

01.111.01 ACRYLAMIDE (1)
01.111.02 ACRYLAMIDE (2)
01.111.03 ACRYLAMIDE (3)
01.111.04 ACRYLAMIDE (4)
01.111.05 METHACRYLAMIDE (1)
01.111.06 METHACRYLAMIDE (2)
01.111.07 METHACRYLAMIDE (3)
01.111.08 METHACRYLAMIDE (4)

01.112.00 ACRYLATE POLYMERS
Synonyms: Acrylic Acid Ester Polymers, Propenate Polymers, Propenoic Acid Ester Polymers
Index Also: Ester Containing Polymers

01.112.01 ACRYLATE (1)
01.112.02 ACRYLATE (2)
01.112.03 ACRYLATE (3)
01.112.04 ACRYLATE (4)
01.112.05 METHACRYLATE (1)
01.112.06 METHACRYLATE (2)
01.112.07 METHACRYLATE (3)
01.112.08 METHACRYLATE (4)

01.113.00 ACRYLIC ACID POLYMERS
Note: Acrylic Anhydride Polymers and Acrylic Acid halide Polymers are included in this group.
Synonyms: Propenoic Acid Polymers, Propenoic Anhydride Polymers
Index Also: Carboxyl Containing Polymers
Anhydride Containing Polymers

01.113.01 ACRYLIC ACID (1)
01.113.02 ACRYLIC ACID (2)
01.113.03 ACRYLIC ACID (3)
01.113.04 ACRYLIC ACID (4)
01.113.05 METHACRYLIC ACID (1)
01.113.06 METHACRYLIC ACID (2)
01.113.07 METHACRYLIC ACID (3)
01.113.08 METHACRYLIC ACID (4)
01.113.09 ACRYLIC ANHYDRIDE (1)
01.113.10 ACRYLIC ANHYDRIDE (2)
01.113.11 ACRYLIC ANHYDRIDE (3)
01.113.12 ACRYLIC ANHYDRIDE (4)
01.113.13 METHACRYLIC ANHYDRIDE (1)
01.113.14 METHACRYLIC ANHYDRIDE (2)
01.113.15 METHACRYLIC ANHYDRIDE (3)
01.113.16 METHACRYLIC ANHYDRIDE (4)

01.113.17 ACRYLOYL CHLORIDE (2)
Synonym: Propenoyl Chloride
Index Also: Acid Halide Containing Polymers

01.114.00 ACRYLONITRILE POLYMERS
Synonyms: Cyanoethylene Polymers, Vinyl Cyanide Polymers
Index Also: Nitrile Containing Polymers

01.114.01 ACRYLONITRILE (1)
01.114.02 ACRYLONITRILE (2)
01.114.03 ACRYLONITRILE (3)
01.114.04 ACRYLONITRILE (4)
01.114.05 METHACRYLONITRILE (1)
01.114.06 METHACRYLONITRILE (2)
01.114.07 METHACRYLONITRILE (3)
01.114.08 METHACRYLONITRILE (4)

01.115.00 ACROLEIN POLYMERS
Synonyms: Acrylaldehyde Polymers, Propenal Polymers
Index Also: Carbonyl Containing Polymers

01.115.01 ACROLEIN (1)
01.115.02 ACROLEIN (2)
01.115.03 ACROLEIN (3)
01.115.04 ACROLEIN (4)
01.115.05 METHACROLEIN (1)
01.115.06 METHACROLEIN (2)
01.115.07 METHACROLEIN (3)
01.115.08 METHACROLEIN (4)

01.120.00 ALIPHATIC POLYMERS
01.121.00 VINYLIDENE HALIDE POLYMERS
Synonym: 1,1-Dihaloethylene Polymers
Index Also: Halogen Containing Polymers

01.121.01 VINYLIDENE CHLORIDE (1)
01.121.02 VINYLIDENE CHLORIDE (2)
01.121.03 VINYLIDENE CHLORIDE (3)
01.121.04 VINYLIDENE CHLORIDE (4)
01.121.05 VINYLIDENE BROMIDE (1)
01.121.06 VINYLIDENE BROMIDE (2)
01.121.07 VINYLIDENE BROMIDE (3)
01.121.08 VINYLIDENE BROMIDE (4)
01.121.09 VINYLIDENE FLUORIDE (1)
01.121.10 VINYLIDENE FLUORIDE (2)
01.121.11 VINYLIDENE FLUORIDE (3)
01.121.12 VINYLIDENE FLUORIDE (4)

01.122.01 VINYLIDENE CYANIDE (1)
Synonym: 1,1-Dicyanoethylene (1)
Index Also: Nitrile Containing Polymers

01.123.00 VINYLENE HALIDE POLYMERS
Synonym: 1,2-Dihaloethylene Polymers
Index Also: Halogen Containing Polymers

01.123.01 VINYLENE CHLORIDE (1)
01.123.02 VINYLENE CHLORIDE (2)
01.123.03 VINYLENE CHLORIDE (3)
01.123.04 VINYLENE CHLORIDE (4)
01.123.05 VINYLENE BROMIDE (1)
01.123.06 VINYLENE BROMIDE (2)
01.123.07 VINYLENE BROMIDE (3)
01.123.08 VINYLENE BROMIDE (4)
01.123.09 VINYLENE FLUORIDE (1)
01.123.10 VINYLENE FLUORIDE (2)
01.123.11 VINYLENE FLUORIDE (3)
01.123.12 VINYLENE FLUORIDE (4)

01.124.00 VINYL HALIDE POLYMERS
Synonym: Haloethylene Polymers
Index Also: Halogen Containing Polymers

01.124.01 VINYL CHLORIDE (1)
01.124.02 VINYL CHLORIDE (2)
01.124.03 VINYL CHLORIDE (3)
01.124.04 VINYL CHLORIDE (4)
01.124.05 VINYL BROMIDE (1)
01.124.06 VINYL BROMIDE (2)
01.124.07 VINYL BROMIDE (3)
01.124.08 VINYL BROMIDE (4)
01.124.09 VINYL FLUORIDE (1)
01.124.10 VINYL FLUORIDE (2)
01.124.11 VINYL FLUORIDE (3)
01.124.12 VINYL FLUORIDE (4)
01.124.13 VINYL IODIDE (1)
01.124.14 VINYL IODIDE (2)
01.124.15 VINYL IODIDE (3)
01.124.16 VINYL IODIDE (4)

01.125.00 VINYL ESTER POLYMERS
Synonym: Carboxlic Acid Vinyl Ester, Polymers
Index Also: Ester Containing Polymers

01.125.01 VINYL ACETATE (1)
01.125.02 VINYL ACETATE (2)
01.125.03 VINYL ACETATE (3)
01.125.04 VINYL ACETATE (4)

01.130.00 AROMATIC POLYMERS
01.130.00 STYRENE POLYMERS
Synonym: Vinyl Benzene

01.131.01 STYRENE (1)
01.131.02 STYRENE (2)
01.131.03 STYRENE (3)
01.131.04 STYRENE (4)

02.000.00 CONDENSATION POLYMERS

02.110.00 POLYETHERS
Synonyms: Oxyalkylene Polymers, Alkylene Oxide Polymers
OXYMETHYLENE POLYMERS
Synonyms: Methylene Oxide Polymers, Polyformaldehyde, Trioxane Polymers

02.111.01 OXYMETHYLENE (1)
02.111.02 OXYMETHYLENE (2)
02.111.03 OXYMETHYLENE (3)
02.111.04 OXYMETHYLENE (4)

02.112.00 OXYETHYLENE POLYMERS
Synonyms: Ethylene Oxide Polymers, Ethane, 1,2-Epoxy Polymers, Dioxane Polymers

02.112.01 OXYETHYLENE (1)
02.112.02 OXYETHYLENE (2)
02.112.03 OXYETHYLENE (3)
02.112.04 OXYETHYLENE (4)
02.112.05 PROPYLENE OXIDE (1)
Synonym: Propane 1,2-Epoxy Polymers
02.112.06 PROPYLENE OXIDE (2)
02.112.07 PROPYLENE OXIDE (3)
02.112.08 PROPYLENE OXIDE (4)

02.113.00 TRIMETHYLENE OXIDE POLYMERS
Synonyms: Propane, 1,3-diol Polymers, Oxetane Polymers

02.113.01 TRIMETHYLENE OXIDE (1)
02.113.02 TRIMETHYLENE OXIDE (2)
02.113.03 TRIMETHYLENE OXIDE (3)
02.113.04 TRIMETHYLENE OXIDE (4)

02.116.00 EPOXY RESINS
Index Also: Epoxy (end)

02.116.01 EPICHLOROHYDRIN (1)
02.116.02 EPICHLOROHYDRIN (2)
02.116.03 EPICHLOROHYDRIN (3)
02.116.04 EPICHLOROHYDRIN (4)

02.120.00 POLYESTERS

02.121.00 POLYMERS FROM HYDROXY ACIDS
Synonym: Polymers from Lactones

02.121.01 GLYCOLLIC ACID ESTER (1)
Synonym: Hydroxy Acetic Acid
02.121.02 GLYCOLLIC ACID ESTER (2)
02.121.03 GLYCOLLIC ACID ESTER (3)
02.121.04 GLYCOLLIC ACID ESTER (4)
02.121.05 HYDRACRYLIC ACID ESTER (1)
Synonyms: Propionic Acid, 3-Hydroxy Polymers, Propionic Acid, 4-Hydroxy Polymers
02.121.06 HYDRACRYLIC ACID ESTER (2)
02.121.07 HYDRACRYLIC ACID ESTER (3)
02.121.08 HYDRACRYLIC ACID ESTER (4)
LACTIC ACID (1)
Synonyms: Propionic Acid, 2-Hydroxy Polymers
Use: GLYCOLLIC ACID ESTER (1) 2-Methyl (side)
02.121.09 4-HYDROXYBUTYRIC ACID ESTER (1)
Synonym: Butyric Acid-4-Hydroxy Ester (1)
02.121.10 4-HYDROXYBUTYRIC ACID ESTER (2)
02.121.11 4-HYDROXYBUTYRIC ACID ESTER (3)
02.121.12 4-HYDROXYBUTYRIC ACID ESTER (4)
3-HYDROXYBUTYRIC ACID ESTER (1)
Synonym: Butyric Acid-3-Hydroxy Ester (1)
Use: HYDRACRYLIC ACID ESTER (1) 3-Methyl (side)
2-HYDROXYBUTYRIC ACID ESTER (1)
Synonym: Butyric Acid, 2-Hydroxy Ester (1)
Use: GLYCOLLIC ACID ESTER (1) 2-Ethyl (side)

02.122.00 POLYMERS FROM ONE DIACID AND ONE DIOL
Synonym: Polymers from one Anhydride and one Diol
02.122.01 ETHYLENE GLYCOL (2)
Synonym: 1,2-ETHANEDIOL (2)
02.122.02 DIETHYLENE GLYCOL (2)
Synonym: 2,2'-OXYDIETHANOL (2)
02.122.03 1,3-PROPANEDIOL (2)
1,2-PROPANEDIOL (2)
Use: ETHYLENE GLYCOL (2) METHYL (side)
02.122.04 1,4-BUTANEDIOL (2)
1,3-BUTANEDIOL (2)
Use: 1,3-PROPANEDIOL (2) 3-METHYL (side)
1,2-BUTANEDIOL (2)
Use: ETHYLENE GLYCOL (2) ETHYL (side)
02.122.09 OXALATE (2)
Synonyms: Oxalic Acid Ester (2) Ethanedioic Acid Ester (2)
02.122.10 MALONATE (2)
Synonyms: Malonic Acid Ester (2)
02.122.11 SUCCINATE (2)
Synonyms: Succinic Acid Ester (2) Butanedioic Acid Ester (2)
02.122.12 GLUTARATE (2)
Synonyms: Glutaric Acid Ester (2) Pentanedioic Acid Ester (2)
02.122.13 ADIPATE (2)
Synonyms: Adipic Acid Ester (2) Hexanedioic Acid Ester (2)
02.122.14 PIMELATE (2)
Synonyms: Pimelic Acid Ester (2) Heptanedioic Acid Ester (2)
02.122.15 SUBERATE (2)
Synonyms: Suberic Acid Ester (2) Octanedioic Acid Ester (2)
02.122.16 AZELATE (2)
Synonyms: Azelaic Acid Ester (2) Nonanedioic Acid Ester (2)
02.122.17 SEBACATE (2)
Synonyms: Sebacic Acid Ester (2) Decanedioic Acid Ester (2)

02.122.18		TEREPHTHALATE (2)
	Synonyms:	Terephthalic Acid Ester (2)
		1,4-BENZENEDICARBOXYLIC Acid Ester (2)
	NOTE:	PETP (POLYETHYLENE TEREPHTHALATE)
	Use:	Terephthalate (2), Ethylene Glycol (2)
02.123.00		COPOLYMERS FROM DIOLS AND DIACIDS
	Synonym:	Copolymers from Diacids and Diols.
		Copolymers from Anhydrids and Diols.
02.123.01		ETHYLENE GLYCOL (3)
	Synonym:	1,2-Ethane Diol (3)
02.123.02		ETHYLENE GLYCOL (4)
02.123.03		DIETHYLENE GLYCOL (3)
	Synonym:	2,2-Oxydiethanol (3)
02.123.04		DIETHYLENEGLYCOL (4)
02.123.05		1,3-PROPANEDIOL (3)
02.123.06		1,3-PROPANEDIOL (4)
		1,2-PROPANEDIOL (3)
	Use:	ETHYLENE GLYCOL (3)
		METHYL (side)
		1,2-PROPANEDIOL (4)
	Use:	ETHYLENE GLYCOL (4)
		METHYL (side)
02.123.07		1,4-BUTANEDIOL (3)
02.123.08		1,4-BUTANEDIOL (4)
		1,3-BUTANEDIOL (3)
	Use:	1,3-PROPANEDIOL (3)
		3-METHYL (side)
		1,3-BUTANEDIOL (4)
	Use:	1,3-PROPANEDIOL (4)
		3-METHYL (side)

LITERATURE CITED

(1) *Chemical Abstracts* **56**, 12N, 83 (1962).

(2) Fox, R. B., J. CHEM. DOC. **7**, 74 (1967).

(3) Huggins, M. L., J. J. Hermons, *et al.*, "Report on Nomenclature in the Field of Macromolecules. International Union of Pure and Applied Chemistry," *J. Polymer Sci.* **8**, 257–77 (1952).

(4) Huggins, M. L., G. Natta, V. Desreux, and H. F. Mark, *Pure Appl. Chemistry* **12**, 645 (1966).

(5) Kokoropoulos, P., Appendix A in E. A. Janning's "The Modification of an Information Retrieval System by Improving Vocabulary Control, Indexing Consistency, and Institute, *Tech. Rept.* **AFML-TR-65-20**, 1965.

(6) *Ibid.*, Appendix I.

(7) Kokoropoulos, P., and F. Scheffler, "The Basic Structure-Substituent Connector," Concept for Handling Organic Compounds for Information Retrieval Purposes, Proceedings ADI, p. 399, 1964.

Division of Chemical Literature Program

156th National ACS Meeting, Atlantic City, N. J., September 9–13, 1968

J. H. Clark, Chairman Margaret S. Hicks, Secretary

MONDAY MORNING

(September 9, 1968)

Symposium on Toxicological Centers

F. R. Benson, Presiding

9:00– Introductory Remarks. Frederic R. Benson

9:10– 1. The American Medical Association Registry on Adverse Reactions. Norman De Nosaquo.

9.40– 2. Input, Handling and Dissemination of Adverse Drug Experience at FDA. Arthur Ruskin.

10:10– 3. Information from and to Poison Control Centers. Henry L. Verhulst.

10:40– 4. Information on Health Aspects of Pesticides. PHILIP C. MINTER, Wayland J. Hayes, Jr.

11:10– 5. An Occupational Health Information Service. Dohrman H. Byers.

MONDAY AFTERNOON

Symposium on Toxicological Centers

F. R. Benson, Presiding

2:00– 6. The Committee on Toxicology and the Advisory Center on Toxicology of the Narional Research Council. Ralph C. Wands.

2:30– 7. Toward a National Systems Resource in Toxicology. Charles N. Rice.

TUESDAY MORNING

(September 10, 1968)

Symposium on Training Chemists in the Use of Chemical Literature, Joint with Division of Chemical Education

G. Jahoda, Presiding

9:00– Introductory Remarks. G. Jahoda.

9:05– 9. The Chemist and Recent Development in Information Systems. I. D. Welt.

9:25–10. An Audio-Visual Guide to the Chemical Literature. O. B. Ramsay.

10:00–11. Who's Teaching Chemical Literature Courses These Days? D. F. Martin, D. E. Robison.

10:20–12. Experimental Course in Information-Gathering for Scientists and Engineers. S. Herner.

10:45–13. Training Chemists in the Use of Chemical Abstracts Service. R. J. Rowlett, Jr.

11:15– Discussion.

12:30– *Divisional Luncheon*, Haddon Hall, Vernon Room (Lounge Floor). Speaker: **Byron Riegel,** Director of Chemical Research and Development, G. D. Searle & Company. Subject: Development of a Chemical Information System for National and International Use.

TUESDAY AFTERNOON

Symposium on Whole Term Searching

K. H. Zabriskie, Presiding

2:00– Introductory Remarks. K. H. Zabriskie.

2:05–13. Term Frequency Data—A Guide to Text Searching Strategy. K. H. Zabriskie.

2:40–14. Use of Word Fragments in Computer-Based Retrieval Systems. J. E. RUSH, D. S. Colombo.

3:15–15. United Kingdom Experiences in the Operation of a Retrieval and Dissemination Service Based on CAS Tapes. A. K. Kent.

3:50–16. Serving the Chemist through the IBM Technical Information Retrieval Center. J. D. Farrell.

4:20–17. Full Text Search of Several Data Bases. M. T. FISCHER, L. Haibt.