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*\*In 1982, the name of the International Superphosphate Manufacturers' Associations (ISMA) was changed to International Fertilizer Industry Association (IFA).*

THE STORAGE AND RETRIEVAL OF TECHNICAL INFORMATION, WITH PARTICULAR  
REFERENCE TO FERTILIZER TECHNOLOGY

By A.K. Scholes  
(African Explosives and Chemical  
Industries Ltd. South Africa)

The examination of technical information relevant to fertilizer technology, in relation to its storage and retrieval, shows that it differs only in detail from information on other technologies. This is not to say that these details are unimportant or are unlikely to lead to difficulties and confusion. We can find no evidence of adequate semantic control by any recognised authority or body of the terminology of the technology, and it is our experience in AE&CI that this lack of guidance leads at times to temporary misunderstanding and confusion - i.e. to a breakdown in communication - which could, and should be avoided.

The tremendous increase in recent years in the amount of information which has to be communicated to the staff of any industry has led to investigation of ways in which optimum effective communication can be achieved. Some of these problems of communication urgently need better solutions and there is no longer room for complacency even at levels of detail such as that of indexing vocabulary. For instance, when you speak of "mixtures" or "blends" of fertilizers, or of "concentrated" fertilizers, or of "compound" or "complex" fertilizers, are identical concepts conveyed to each of you by each term ?

Do some of you regard the terms "compound" and "complex" as synonymous and others not so ? Whether you do or whether you don't, can you define them so that what they mean to you can be conveyed without ambiguity to another mind ? At least one ISMA committee has attempted to define some of these terms, albeit for the purposes of one report and we would refer you to report LE/63/78 of November 1963, prepared by the ISMA Complex Fertilizer Committee.

Furthermore, in an international organisation such as ISMA, with two official languages, are you satisfied that concepts in one language are conveyed with optimum efficiency in the other ? For instance, we have noticed the use in some English titles of papers presented to earlier ISMA meetings of "sulphurous anhydride". This is not incorrect and is clearly a direct translation from the French "anhydride sulfureux", but to those of you who follow the English version or who translate from English into another language, would not the use of "sulphur dioxide" have conveyed the concept more effectively ? No doubt our French speaking colleagues can also cite examples of this sort of thing from their side.

Before leaving this matter of the meaning of terms we would draw your attention to a section of a USDA/TVA publication, "Superphosphate - Its history, chemistry and manufacture", (1) headed "Nomenclature". Six alternative terms stated to be used frequently, for "normal" superphosphate are listed, all of which are vague and imprecise - e.g. "regular", "ordinary", "standard", etc. Similarly it is stated that "concentrated superphosphate" is frequently called "double", "treble", "triple" or "multiple" superphosphate. With respect, we submit that the use of such loose terms can only lead to confusion at times and certainly ignores the differentiations by definition of regulations laid down by various governments. For instance, in the South African regulations it is stated (2) that "No fertilizer shall be registered or sold under the name ..... (b) double superphosphate (double super) unless it is a fertilizer which contains at least 18.5% water-soluble phosphorus". These regulations contain no reference whatsoever to "concentrated", "triple" or the other names for similar material, and with the exception of reference to elemental phosphorus as opposed to P<sub>2</sub>O<sub>5</sub>, appear to be typical of the current position, viz : that each country has selected one of the alternatives and provided an official local definition.

The foregoing examples lead me to discussion of two important matters. Firstly, that the total quantity of technical information now available in numerous technologies, including fertilizers, is so large that no one can remember it all, however, erudite they may be. Secondly, like technical people in other industries we are confident that it is the information as opposed to the documents containing it, in which you are interested. In AE&CI we have found it essential to draw this distinction, and we have based our procedures on our experience that technical staff require to retrieve information with a minimum of mental effort, and to do so on a self-help basis. Thus, in dealing with both published and unpublished information - i.e. information confidential to AE&CI - our efforts have been directed towards establishing user confidence. If information is in the systems, users can find it, and do so quickly without having to concern themselves with the mechanics of the systems.

You will be well aware that all sorts of systems are in use throughout the world, some designed for document retrieval, as are most computerized systems, and some for information retrieval. However, they all have one aspect in common, namely that some form of control of indexing vocabulary is essential. And it is in this matter that an international body such as ISMA can be of assistance to the fertilizer industry throughout the world by ensuring that the terminology of its technology is in good order - i.e. that imprecise terms are dropped if possible, that synonyms and near-synonyms are clearly defined, and that widespread use of such definitions is actively encouraged. In our discussions with fertilizer specialists it is evident that many of you would welcome such steps to improve the efficiency, and hence effectiveness of the communication of relevant concepts between you. The desirability of such improvements appears to extend from staff engaged in research and production to others concerned with agronomic and sales matters.

At the end of this paper we have put forward several proposals which we believe to be practical and desirable. Some arise from the foregoing and others from our experience in AE&CI in the provision of information retrieval systems. An outline of these retrieval systems follows but we would also just mention in passing that they comprise one aspect only of our technical information services. We are equally active in providing current awareness, selective dissemination of new information and report writing advisory services.

We concluded some years ago that the commercially available abstracting services covering the journal literature in the field of fertilizer technology, are comprehensive and in general adequate. In our opinion the preparation of abstracts of journal articles by ourselves for storage and retrieval purposes could not, therefore, be justified. It is less expensive to buy this service than to provide it oneself and so we rely on Chemical Abstracts, Soils and Fertilizers, NPK Abstracts, Chemische Zentralblatt, Biological & Agricultural Index, etc. for the retrieval of published information. Taken together, these services meet our requirements although some are better than others, and it is our intention to be more active in future in giving the publishers constructive criticism. In our experience most publishers welcome this sort of contact with their customers, and we believe that it is up to the members of such organisations as ISMA to bring pressure to bear on the publishers for the provision of improved services.

Obviously published services are of no assistance in dealing with internal documents such as technical reports, but they can at least provide a guide for some courses of action - e.g. as most of our technical staff are chemists or chemical engineers they are particularly familiar with Chemical Abstracts. When working out our own systems we have not hesitated therefore to adopt most of the conventions (i.e. symbols, abbreviations, etc.) used by Chemical Abstracts. By 1962 we had approximately 20,000 reports on file (1968 total = 30,000) of which several hundred concerned fertilizers. It was realised that we had outgrown the few simple indexes which we had and that we were in urgent need of a comprehensive information retrieval system.

The system which we developed has been described in greater detail elsewhere (3). We named the system "TIRSS" (Technical Information Retrieval & Storage System). TIRSS is a manual alphabetical card index with the contents of each card divided into bibliographic information, informative type abstracts and indexing terms (see Figure 1). Bibliographic information is necessary for identification and location of each document, however, by providing informative type abstracts, as opposed to indicative abstracts, we have found that the need to consult original documents is reduced very substantially. (Note: An informative abstract summarises the information in a document whereas an indicative abstract merely states what subjects are dealt with). You will realise that the cost of providing informative abstracts (and we use technical graduates for our abstracting and indexing

requirements) is higher than for indicative abstracts. However, the justification is that the former, in conjunction with deep indexing, provide a partial substitute for original documents and enable searchers to decide whether or not they need to consult the original. As the searchers for information are usually relatively highly paid staff, one is saving money by saving their time. Of course, the provision of any service costs money and we have simply transferred a high percentage of the total cost to the system input side in order to benefit from the ease with which users can find what they want - i.e. the output side costs relatively little.

From experience we know that the average chemical subject report requires 10-15 indexing terms to ensure efficient retrieval of the information in it. We index at this level and also use role indicators to show the aspect (or "role") of the information; these are set out in Figure 2. They enable us to separate information on various basic concepts, such as raw materials (role 1), end products (role 2), analytical methods (role 4), etc.; in effect their use gives us eleven intersorted indexes. A most important aspect of TIRSS is that we provide a copy of each card for each subject index term as well as for author and various numerical indexes. Thus in the sample shown in Figure 1 there are ten cards - seven subject cards, one author card, one for the pamphlet number and one for the master number file. The master number file is provided for insurance purposes in case the index should be destroyed, and is housed on a different site.

When TIRSS was set up it was decided that various documents other than internal technical reports should be included, since there are numerous items which are not abstracted by the commercial abstracting services referred to earlier. As you will see from Figure 1 we include all ISMA technical papers in the system.

From TIRSS's inception we realised that it would be necessary to build-up our own Thesaurus of indexing terms; currently our list comprises about 55,000 pre-coordinated compound terms and of these about 15,000 are cross-reference entries - i.e. "see" and "see also" entries. Some of you may question the need for the provision of a Company Thesaurus when so many such lists can be bought. Apart from the inability of commercially produced lists to cater for local terms they unavoidably provide terms of no interest to a particular company or do not provide enough terms for subjects of major interest. For instance, the American Engineers Joint Council Thesaurus provides about 20 terms for the whole of fertilizer technology whereas AB&CI's requirements are for about 200 terms.

Up to mid-1968 approximately 50,000 documents had been examined for possible inclusion in TIRSS. Of these, almost half have been processed into the system and the rest have been rejected as being of insufficient value or of temporary value only. Clearly, the justification for the system's continued existence lies in the use made of it. From about two years after the first abstracts were prepared, usage increased quickly as staff "discovered" the system

and gained confidence in its reliability. Current usage is averaging about 100 searches per month which we consider satisfactory. Staff are willing to use the system themselves without calling for assistance, so that the major objective of simplicity as far as the user is concerned has been achieved. Browsing is evident, and in order to discourage the unauthorised removal of cards and the wasting of time in copying abstracts by hand, an electrostatic copier is installed in the filing room and is also available for use on a self-help basis.

In mid-1966 we extended the use of our Thesaurus to indexing of that small percentage of correspondence which contains technical information of long-term value. This application was successful and sample cards are illustrated in Figure 3. Here, you will notice, a title rather than an abstract is provided so that the system leads to document retrieval. Since correspondence is by nature in the form of relatively short communications, we consider this procedure to be satisfactory. This success encouraged us to experiment further, since it was apparent that we had gained adequate experience of our system to know that it met our requirements. Further, we believed that it would continue to do so for many years.

Since 1954 we had used the well known Universal Decimal Classification (UDC) System in our Research Department library but we were dissatisfied with it. Like all conventional library classification systems, UDC provides a "browsing facility" and a document retrieval service. We desired to retain the browsing facility but wished to introduce information retrieval so as to encourage users to help themselves, and to do so with confidence that they could find what they wanted as in searching TIRSS. Most library users in our experience are not prepared to make the effort to understand systems such as UDC and they neither like working through numerical codes nor having to consult library staff, who usually have little or no technical knowledge. Furthermore, systems such as UDC do not permit the deep indexing of technical documents, most of which cover several subjects, without the use of long and essentially impractical strings of numbers. Many librarians have been aware of these difficulties for a long time and have attempted to get round the problem by means of such alphanumeric systems as Faceted Classification. However, these systems are still dependent on codes, which users avoid if they possibly can.

We experimented, therefore, for about six months with ideas and procedures derived from TIRSS and eventually developed the system which we named LIBRIS (Library Information System). Our library contains about 10,000 books and about 10,000 pamphlets - i.e. all those many documents ranging from published reports to reprints, from the publications of learned societies to journal articles translated from other languages. From our experience with TIRSS we realised that in addition to getting new books, etc., into LIBRIS, usage of the new catalogue would be small for a long time - and hence the return on the investment would be poor for a long time - unless we reclassified the existing book stock. Up to

mid-1968 we had about 3,500 documents in the new catalogue. As with conventional catalogues it comprises three sections, viz : subject, author and classified sections. The classified section is based on the use of simplified UDC numbers for shelving purposes, so that we can continue to group books on like subjects and so retain the browsing facility. Examples of a LIBRIS subject card, of the reverse side of a classified section card and of an issue card are shown in Figure 4. As in TIRSS the cards provide bibliographic information, abstracts and index terms and are filed alphabetically. The abstracts are merely indicative, however, and are usually compiled quickly from chapter headings, introductions etc. The indexing terms are taken from our Thesaurus and no role indicators are used. In this way the work of preparing these cards is simplified, which enables us to use our original classifiers - i.e. non-technical staff - for the job. At the same time we provide a card for each subject, indexed as in TIRSS, and by showing the index terms all together on each card, users obtain adequate information to decide whether or not a book is worth looking at. We have tackled reclassification subject-by-subject so that already it is complete in particular subject fields. This has encouraged our staff to use the system and we have found it most encouraging that LIBRIS is popular with them. Strictly speaking LIBRIS is not a true information retrieval system since indicative and not informative abstracts are provided. However, it offers far more than a true document retrieval system such as that for our technical correspondence. Thus it is probably more correct to call it a hybrid system, but one that is as close to being an information retrieval system as we can get without increasing costs substantially (by employing technically qualified staff as "classifiers") and without reducing the practicalness; we have found that it is virtually impossible to write informative abstracts for most books.

Thus by using our Thesaurus as the starting point for indexing all kinds of documents we are tying the library, central report files and technical correspondence files together to comprise an integrated information retrieval set-up. The Thesaurus remains open-ended - i.e. we can add or delete terms as necessary. We have recently transferred it to punched cards so that computer print-outs can be obtained as necessary for updating purposes. Figure 5 shows a page of an experimental print-out where the letters L (for LIBRIS), T (for TIRSS) and C (for correspondence files) are included singly or in appropriate combination to show where information on any subject can be found. Thus when a problem arises staff can consult one document, the Thesaurus, in order to determine whether and where information is available. We believe that during the next few years this will prove to be a very valuable development in the efficient and speedy retrieval of information from the various document files we have.

Finally, we wish to put forward the proposals referred to earlier for your consideration as members of ISMA. We do so in the belief that, if adopted, they will assist all of us to cope more effectively with the problems engendered by the ever increasing quantity of technical information relevant to fertilizer technology. We are convinced that the most economic way to deal with that part of the

problem arising from ISMA papers is the systematic preparation of summaries or abstracts and lists of index terms as near to source as possible. This will remove the need for repetitive abstracting and/or indexing which we are quite sure is done by the libraries and information services of many members' organisations.

### Proposals

1. That all authors should be asked to provide informative summaries of their papers for inclusion in conference pre-prints and published proceedings. We have attached a summary of this paper as an example - see Appendix I.
2. That all authors provide a list of suggested index terms for their papers to facilitate retrieval of the information in them in the future - such lists to be subject to amendment by the Secretariat - see 3 below.
3. That the Secretariat should draw up lists of acceptable indexing terms in English and French, listing synonyms and the relationships of generic and specific technical terms. In this task they should be free to draw on the experience and opinions of members and of outside bodies or individuals. This list should be both distributed to members and also published and sold with the objectives of defraying expenses and of obtaining the widest possible use of the agreed terms.
4. That one cumulative index to all technical meetings pre-dating the issue of the agreed list be prepared, comprising titles, authors and agreed index terms.
5. That the proceedings of future ISMA technical meetings should be indexed by the Secretariat working from authors' suggested terms, modified as necessary to ensure use of the agreed terms only. Such indexes to be included in bound copies of proceedings.
6. That cumulative indexes be prepared in future at, say, ten yearly intervals, comprising the summaries of all papers presented, together with index terms and an author list.
7. That a small sub-committee be appointed to assist the Secretariat in keeping up-to-date with members' documentation requirements.

It is probable that your Secretariat will be able to add to the above proposals because of their more intimate knowledge of both the fertilizer trade and of ISMA itself. But whatever the source of any further proposals may be, we would like to stress that, investment in documentation is an economic proposition, provided the system is well planned in advance. It leads to direct savings in staff time and in the avoidance of the duplication of work already done and reported by others, and to the stimulation



of new ideas by improved access to other peoples ideas.

REFERENCES

1. USDA/TVA; Superphosphate : Its History, Chemistry and Manufacture; U.S. Government Printing Office, Washington DC (1964)
2. Proclamation No. 1541, Government Gazette No. 622; Fertilizer Regulations; Government Printer, Pretoria (1963)
3. Scholes, A.K.; Storage and Retrieval of technical information; South African Chem. Proc., 1, 5, 137-140 (1966-67).

**FIGURE 1 : EXAMPLE OF ABSTRACT IN TIRSS****EXEMPLE D'EXTRAIT DE TIRSS**

(1)

PAMPHLET NO: P.M. 15, PA/ 66/ 15  
 SOURCE : The International Superphosphate Manufacturers' Association Ltd., U. K.  
 AUTHOR : H. ALIBERT  
 TITLE : RESULTS OF FERTILISER TRIALS ON VINES, (PLACEMENT IN DEPTH)  
 AVAILABLE : Library files, Research Department, AEECL.

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**ABSTRACT**

These trials confirm the advantages of fertilizer placement in depth on vines.

For vines, however, because of the penetration of P and K below the level of fertilization, it is not usually necessary to apply the fertilizer too deep, particularly in the case of older vines where the root system is spread over the whole area of the furrow. It is advisable to place it below the plough pan formed by the winter ridges, so as not to disturb the fertilizer. This necessitates strict control of the depth of fertilization which is effected by cutting a narrow trench before and after application to the first 10 or 20 metres.

**INDEX TERMS**

FERTILIZATION PRACTICE -9  
 FERTILIZERS - APPLICATION -4  
FERTILIZERS - APPLICATION RATE  
 FIELD EXPERIMENTS -4

VINE CROPS -7  
 VINE FERTILIZATION -9  
 VITICULTURE -9

Card 1/1

(1) Colour code indicating year of publication, to facilitate patent searches in particular

(2) Bibliographic information

(3) Informative type abstract

(4) One index term always underlined in red indicating where filed. Numerals are role indicators.

(5) Master number

(1) Couleur code indiquant l'année de publication pour faciliter les recherches de brevet en particulier

(2) Information bibliographique

(3) Extrait du type informatif

(4) Un mot clé seulement toujours souligné en rouge pour indiquer le lieu de classement. Les nombres sont des indicateurs de rôle.

ROLE INDICATORS AS USED IN TIRSS

Roles are used to define for each term a function or context, an element of syntax, or a "part-of-speech" orientation. One of eleven numbers (0 to 10) indicating the appropriate role is appended to each term.

The meaning of the roles are, briefly :

- 0 Bibliographic data, place names.
- 1 Input, raw material, ingredient.
- 2 Output, product, mixture.
- 3 Undesirable material, contaminant, impurity.
- 4 Means used, methods, procedures, devices.
- 5 Media.
- 6 That which affects.
- 7 That which is affected.
- 8 Primary topic of consideration.
- 9 Passive recipients, possession.
- 10 Indicated uses.

Roles are assigned to each of the index terms selected by the indexers. In TIRSS they are used as sub-headings and serve a useful purpose in limiting the number of cards which have to be consulted during any search. If information is sought, for example, on the appearance of a substance as a contaminant in a second substance, only the cards under Role 3 need be examined, or if a substance is used as a raw material, only those cards under Role 1.

FIGURE 2

FIGURE 3 : CORRESPONDENCE INDEXING CARDS  
FICHES D'INDEXATION DE CORRESPONDANCE

Index Term - Mot Clé	Date -	File No.-Dossier No.	Aspect of subject dealt with Genre de sujet traité	1967			
Originator (↑) or Addressee (↓) - where no arrow : copy for information  Origine (↑) ou Destinataire (↓) - pas de flèche : copie pour information	<b>FERTILIZERS</b>						
			Agricul. Div.	Extn. of anhydrous amm. application	↑ S.W. Branch	Wheat Germination	
	Apr 12	2.41			July 6	2.41	Problems in the Western Cape
			C.S.D.	Ammonium Phosphates	S.W. Branch		Effects of Nitrogen on Wheat Germination
	May 16	2.1			July 17	2.41	
			Univ. of Stellbch.	Fertilizer for Grain Sorghums	↑ Durban Branch		Report on the Seminar organised by the Sugar Agronomists Ass. 29.8.67
	June 7	2.41			Sept 1	2.	
			Univ. of Stellbch.	Fertilizer for Grain Sorghums	Agricul. Div.		Basic Double Superphosphate
	June 16	2.41			Oct 19	2.112	
			Swazi. Govt.	Potassium Sulphate	↑ Scottish Agr. Indus.		Phosphatic Fertilizers
June 29	2.1			Oct 23	0.4		

Originator	Address	Date	Subject
AGRICULTURAL DIVISION	Formulations Grp.	Jan 3	3.12
	Analytical Grp.	Jan 17	7.3
	Allied Chem. Corp.	Jan 26	3.3
	Agri. & Biol. Grp.	Jan 24	2.311
	Somerset Branch	Feb 1	7.4
	Formulations Grp.	Feb 27	7.4
	Formulations Grp.	Feb 28	3.11
	Formulations Grp.	Mar 6	3(1)
			Dieldrin MO

The top card is a white subject card and the lower one is a green "author" card.  
La fiche supérieure est une carte blanche de sujet. La fiche inférieure est une carte verte d'auteur.



FIGURE 5EXTRACT FROM EXPERIMENTAL THESAURUS PRINT-OUT

2271000	MAGAZINE (EXPLOSIVES) - VENTILATION	C
2272000	MAGNESIUM COMPOUNDS	T
2273000	MAGNESIUM - CORROSION	L
2274000	MAGNESIUM DEFICIENCY	T
2275000	MAGNETIC PROPERTIES	LT
2276000	MAGNETIC PROPERTIES - DETERMINATION	L
2277000	MAGNETIC SEPARATION	
2278000	SEE ALSO BENEFICIATION	
2279000	MAGNETIC STIRRING	L
2280000	MAGNETISM	CL
2281000	MAINTENANCE - INCENTIVE BONUS SCHEMES	LT
2282000	MAINTENANCE - SAFETY	L
2283000	MAINTENANCE STANDARDS	LT
2284000	MAIZE - BIBLIOGRAPHY	T
2285000	MAIZE DISEASES	T
2286000	MAIZE - FLOWERING	L
2287000	MAIZE OIL	C
2288000	MAIZE OIL	
2289000	SEE ALSO OIL (VEGETABLE)	
2290000	MAIZE STALKS BORERS	
2291000	SEE STALK BORERS	
2292000	MALATHION* - DETERMINATION	T

INFORMATIVE ABSTRACT OF THE ATTACHED PAPER

NOTE : An informative abstract is synonymous with a good summary and it should be remembered that the summary is frequently the only part of a paper or report which senior management in particular will read.

A discussion of some common imprecise terms in the fertilizer trade, which can lead to confusion in the communication of information, is followed by reference to the need for information retrieval services resulting from the rapid increase in knowledge, and to the need to distinguish between document retrieval and information retrieval. AE&CI's information retrieval system, primarily for internal documents and named TIRSS, comprises an alphabetical manual card index, informative abstracts and deep indexing. Role indicators are used and a copy of each card is filed under each index term. A Thesaurus of index terms has been developed and has also been applied to indexing technical correspondence. More recently a new library information system (LIBRIS) has been developed comprising indicative abstracts and index terms from the Thesaurus, with a card filed under each index term. These systems are popular with users and are being tied into one integrated system with the Thesaurus as the pivot. Several proposals for the provision of abstracts and index terms to assist members of ISMA are put forward.