CHEM/SDI SERVICE: PERFORMANCE OF CAN/SDI SOFTWARE

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INTRODUCTION

CHEM/SDI service is a computerised SDI (Selective Dissemination of Information) service covering chemistry and allied disciplines. CHEM/SDI is also a pilot project of UNISIST/UNESCO for one year in the region of South Asia covering countries like Iran, Afghanistan, Pakistan, Nepal, Bangladesh, Burma, Sri Lanka and India. There are about 125 users from India, Nepal and Sri Lanka for CHEM/SDI. The service is fortnightly and uses CAC (Chemical Abstract Condensate) magnetic tape supplied by the American Chemical Society. Canada through Unesco provided the software and the training. This software is called CAN/SDI package. India got a subset of CAN/SDI package. CHEM/SDI is currently using a subset of India package which can run under OS-MFT/MVT or OS/VS. The implementation of program package for CHEM/SDI has already been discussed [1]. The present paper discusses the in-situ working of CHEM/SDI software over a period servicing nearly 18 issues of CAC.

Software Design

The current practice in IR (Information Retrieval) software is to develop as general a system as possible so that most of the bibliographic data bases can be used by the system. Since the key program of IR software is 'search program' it is usually written in a very compact form in the system's assembly language. Basically IR package must contain a search program, a program for compiling profile and a program for printing the answer. In an environment of multiple data bases, this approach will require one compile program for profiles and as many search programs as there are data bases and perhaps one print program. As an alternative to this, there is another approach. In this the search, print and compile profile programs are kept invariable and every data base brings with it a conversion program which transforms the format of a data base into that of the search. This approach enables to design an open ended system, keeps the running and other developmental cost at a low level. CAN/SDI uses this approach for providing SDI service to over 2,000 users across Canada from about dozen data bases.

Overview of CAN/SDI System

Annexure 1 presents a chart for the CAN/SDI software package. As stated earlier the package can run under OS-MFT/MVT or OS/VS, OS/TSS on IBM/360 or 370 or a compatible machine. The system requires a core memory of the order of 512 K bytes and the India package can run on 384 K bytes. The peripheral configuration for the package is minimum of three tape drives for 800/1600 BPI, a disk drive, a card reader-punch and an on line printer. CAN/SDI package uses PL/1 and the assembly language. The crucial program of the package viz., search uses assembly languages. It must be stated that various advanced programming concepts have been deftly implemented in the package.

Phases of CAN/SDI System

in general there are five phases in CAN/SDI for providing SDI services. These are
1) Conversion phase;
2) Compile profile phase;
3) Search phase
4) Sort phase; and
5) Print phase
The first two phases constitute the Input and the last phase is the Output of the system. Phases three and four process the SDI bulletin or printouts.

**CHEM/SDI Package**

CHEM/SDI package is a subset of India package. Originally it contained the following programs:

1. CHEMABS;
2. Compile Profile;
3. Search; and
4. Print

CHEM/SDI uses sort utility program of OS package. During trial runs it was found necessary to add one more program. This program is written in assembler and it checks and prints any errors in the feedback addresses and user address.

Chemabs is the conversion program written in PL/I for reformattting the CAC into search format which is a modified version of MARC-II format. It has number of routines which are written in PL/I and same are in assembler. The program is table driven and uses preprocessor variables.

Compile profile program is a PL/I program. It tests profile terms along with the alpha codes and generates search expressions. These search expressions are a version of pseudo instructions which form a part of input to search program.

Search program is in assembler and is made up by several macros. It takes a maximum of 50 profile in a single pass and runs the records from the converted data bases.

Print program is a PL/I program. It uses the sorted hits, the user address and the feedback address as input. As output the SDI print out in either a single or double column printing together with operational data punched on cards is produced.

**CHEM/SDI flow chart is given in annexure I.**

In the subsequent treatment, an attempt will be made to present the performance of CHEM/SDI software on IBM/370 model 155-II installed at the computer centre of I.I.T. Madras.

**Inputs**

The CHEM/SDI package accepts two inputs.

a) CAC data base; and
b) Profile information

**Data Base**

The CAC data base is air flown to India. The package has already processed 18 issues of CAC 1976

The description of a record of CAC is as follows:

**Description**

A record in Standard Distribution Format is in OS/360 variable length blocked form. Maximum record length is 3516 bytes, maximum block size is 3520 bytes. Tapes are unlabelled and in ASCII character representation.

A record in SDF is analogous to a record in the MARC II format in that it consists of three parts: a leader, directory and text.

**A. Leader** - First 8 bytes of every record.

Bytes 1-4: Overall record length. This field is accessible only to the OS data management system.

5-6: Reserved for future use. Current value is hex '00'.

7: Record modification code used by CAS software system.

8: A number whose binary value equals the number of entries in the directory.

**B. Directory** - Each entry in the directory is 8 bytes long. There are as many directory entries as there are items in the text.

Bytes 1-2: Tag identifier (in hexadecimal notation).

3: Bits 1-4: Code to indicate storage mode of the text associated with the tag identifier. Current values for this field are:

<table>
<thead>
<tr>
<th>Bytes</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0111</td>
<td>ASCII (7 bit ASCII with 8th bit 0)</td>
</tr>
<tr>
<td>1001</td>
<td>Arbitrary bit string or byte string</td>
</tr>
</tbody>
</table>

Bits 5-8: If the length of the text being pointed to is longer than 4 bytes, then these bits have the value of '0000'. If length of text is 4 bytes or less, then value stored is this length in binary form. The actual text in this latter case is stored in bytes 5-8 of the directory entry.

4: Tag I.D. modifier. If at any time the specification of the Tag ID changes, then this modifier is changed to flag the revision. This byte is also used as a counter in...
multiple entry fields. E.g., if we have 3 authors, there will be 3 directory entries with a tag ID for author, but byte 4 of the entries will contain hex 1, 2, and 3 respectively.

5-6: A number whose binary value is the starting address of the text relative to the beginning of the record (counting begins with zero).

7-8: A number whose binary value is equal to the exact length in bytes of the piece of text being pointed to.

Note: The above description of bytes 5-8 apply provided that bits 5-8 of byte 3 have the value '0000'. If those bits have any other value, then bytes 5-8 contain the actual text (left justified).

C. Text - There are a varying number of text items, each of which can be of varying length. Storage mode of a text field is indicated by bits 1-4 of byte 3 of the directory entry for that text.

CAC Tag Identifiers

The following list gives the CAC tag identifiers in decimal form, along with what they point to. For more detailed description of these data elements, refer to the CAS publication 'Data Content Specifications for CA Condensates in Standard Distribution Format'.

Note: Data elements tagged with '*' below are not included in the NRC data base.

* 18 Sequence number
* 84 Temporary abstract number (TAN)
  85 CODEN
  86 Publication classification code
  89 Authors - up to 10 personal authors
      - up to 10 corporate authors
  90 Location of work (usually author affiliation)
  91 Document title
  92 Original (foreign) book title
  93 Abbreviated title of publication, or the country of a patent
  94 Publication date
  95 Series/volume number
  96 Issue/report/part number
  97 Pagination
* 98 Country of patent application or priority code
  99 Original language (both a code and a language name)
 100 Availability
 101 Price
 102 CAS publication citation
 103 CAS publication section/subsection
 107 CAS coverage
  109 Copy abstract, parent journal, or book review citation
  111 Date of meeting or volume
  112 Patent number
  113 Patent assignee
  114 Patent classification number
  115 Date of patent application or priority
  116 Publisher
  119 Keyword phrase
* 325 Record creation date
* 328 Data element ID frequency count(s)
* 329 File key description
* 330 CAS issue(s) identification
* 331 Tape format escape code
* 332 Number of file units
  789 Patent application or priority number.

Profile

A profile is a list of keywords and other related words. Each of these words is preceded by a two letter alpha code. Each profile has a mailing address and a maximum of ten expressions. Maximum number of profile terms is restricted to 200. Each expression is allowed to retrieve 99 references from a data base. This means that a user can have a bibliography with maximum of 990 references.

Expressions are formed by using Boolean logic on the profile term code. These are alpha codes connected by 'OR' 'AND' '+' 'Through' '-' '-' AND NOT' '--', and 'inclusive' '()' symbols.

Annexure 3 gives the filled in proforma for collecting the profile information. Annexure 4 gives the coded version of this profile. Annexure 5 gives the 'Profile listing' as processed by 'Compile Profile' program.

Operating CHEM/SDI Software

The following operations are needed to produce one SDI printout:

1) Receive the tape;
2) Convert the tape;
3) Update the profile file;
4) Search the tape;
5) Sort the hit file;
6) Print the sorted hit file profile wise; and
7) Collected the statistical card punched by package.

Receive Tapes

CAC Tapes are received on a weekly basis as even and odd numbered tapes. These tapes are processed on a two weekly basis i.e. one odd and one even tape.

Conversion

Two CAC tapes, one even and one odd, are transformed into the search format consecutively.
That is to say, issues 1&2, 3&4, etc. are converted into search format simultaneously by using 'CHEMABS' program. The table below gives the execution timings for the runs of Chemabs so far taken:

Table 1: Execution Timing of Conversion Phase

<table>
<thead>
<tr>
<th>Run No.</th>
<th>CAC Tape</th>
<th>No. of MARC Records created</th>
<th>CPU Time Min.</th>
<th>Sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>84</td>
<td>1</td>
<td>5407</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>84</td>
<td>2</td>
<td>6751</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
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<td>5582</td>
<td>12</td>
</tr>
<tr>
<td>4</td>
<td>84</td>
<td>4</td>
<td>7860</td>
<td>17</td>
</tr>
<tr>
<td>5</td>
<td>84</td>
<td>5</td>
<td>5903</td>
<td>13</td>
</tr>
<tr>
<td>6</td>
<td>84</td>
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<td>6397</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>84</td>
<td>7</td>
<td>6226</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>84</td>
<td>8</td>
<td>8969</td>
<td>21</td>
</tr>
<tr>
<td>9</td>
<td>84</td>
<td>9</td>
<td>6365</td>
<td>14</td>
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<td>10</td>
<td>84</td>
<td>10</td>
<td>9108</td>
<td>20</td>
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<td>84</td>
<td>11</td>
<td>5501</td>
<td>13</td>
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<td>12</td>
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<td>12</td>
<td>9168</td>
<td>22</td>
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<td>13</td>
<td>84</td>
<td>13</td>
<td>6790</td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>84</td>
<td>14</td>
<td>8359</td>
<td>18</td>
</tr>
<tr>
<td>15</td>
<td>84</td>
<td>15</td>
<td>7131</td>
<td>15</td>
</tr>
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<td>16</td>
<td>84</td>
<td>16</td>
<td>9406</td>
<td>21</td>
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<td>17</td>
<td>84</td>
<td>17</td>
<td>6870</td>
<td>16</td>
</tr>
<tr>
<td>18</td>
<td>84</td>
<td>18</td>
<td>7611</td>
<td>17</td>
</tr>
</tbody>
</table>

Table 2: Execution for the Sort Phase

<table>
<thead>
<tr>
<th>Run No.</th>
<th>No. of Profiles</th>
<th>No. of Records Sorted</th>
<th>CPU Time Min.</th>
<th>Sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>3030</td>
<td>0</td>
<td>12.25</td>
</tr>
<tr>
<td>2</td>
<td>33</td>
<td>4910</td>
<td>0</td>
<td>16.22</td>
</tr>
<tr>
<td>3</td>
<td>57</td>
<td>8104</td>
<td>0</td>
<td>23.56</td>
</tr>
<tr>
<td>4</td>
<td>73</td>
<td>9790</td>
<td>0</td>
<td>27.73</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
<td>736</td>
<td>0</td>
<td>5.02</td>
</tr>
<tr>
<td>6</td>
<td>21</td>
<td>2356</td>
<td>0</td>
<td>8.76</td>
</tr>
<tr>
<td>7</td>
<td>83</td>
<td>5103</td>
<td>0</td>
<td>16.77</td>
</tr>
<tr>
<td>8</td>
<td>90</td>
<td>8662</td>
<td>0</td>
<td>25.32</td>
</tr>
<tr>
<td>9</td>
<td>104</td>
<td>17878</td>
<td>0</td>
<td>54.01</td>
</tr>
<tr>
<td>10</td>
<td>109</td>
<td>18742</td>
<td>0</td>
<td>55.32</td>
</tr>
<tr>
<td>11</td>
<td>114</td>
<td>17548</td>
<td>0</td>
<td>53.64</td>
</tr>
<tr>
<td>12</td>
<td>115</td>
<td>14728</td>
<td>0</td>
<td>43.73</td>
</tr>
<tr>
<td>13</td>
<td>116</td>
<td>16292</td>
<td>0</td>
<td>48.18</td>
</tr>
<tr>
<td>14</td>
<td>118</td>
<td>15828</td>
<td>0</td>
<td>46.83</td>
</tr>
</tbody>
</table>

Table 3: Execution of the Print Phase

<table>
<thead>
<tr>
<th>Run No.</th>
<th>No. of Profiles</th>
<th>No. of Records Sorted</th>
<th>No. of Lines Printed</th>
<th>CPU Time Min.</th>
<th>Sec.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30</td>
<td>3030</td>
<td>10,250</td>
<td>1</td>
<td>43.37</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>736</td>
<td>5,250</td>
<td>0</td>
<td>54.27</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>4910</td>
<td>34,950</td>
<td>5</td>
<td>28.31</td>
</tr>
<tr>
<td>4</td>
<td>57</td>
<td>8104</td>
<td>38,550</td>
<td>6</td>
<td>57.77</td>
</tr>
<tr>
<td>5</td>
<td>73</td>
<td>9790</td>
<td>59,450</td>
<td>11</td>
<td>39.62</td>
</tr>
<tr>
<td>6</td>
<td>21</td>
<td>2356</td>
<td>16,750</td>
<td>2</td>
<td>41.97</td>
</tr>
<tr>
<td>7</td>
<td>83</td>
<td>5103</td>
<td>29,650</td>
<td>4</td>
<td>25.70</td>
</tr>
<tr>
<td>8</td>
<td>90</td>
<td>8662</td>
<td>62,750</td>
<td>9</td>
<td>51.28</td>
</tr>
<tr>
<td>9</td>
<td>104</td>
<td>17878</td>
<td>1,01,450</td>
<td>16</td>
<td>13.74</td>
</tr>
<tr>
<td>10</td>
<td>109</td>
<td>18742</td>
<td>D.S.O.</td>
<td>17</td>
<td>40.04</td>
</tr>
<tr>
<td>11</td>
<td>109</td>
<td>18742</td>
<td>D.S.O.</td>
<td>17</td>
<td>51.71</td>
</tr>
<tr>
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<td>114</td>
<td>17548</td>
<td>D.S.O.</td>
<td>17</td>
<td>20.97</td>
</tr>
<tr>
<td>13</td>
<td>115</td>
<td>10,650</td>
<td>D.S.O.</td>
<td>1</td>
<td>52.51</td>
</tr>
<tr>
<td>14</td>
<td>115</td>
<td>10,650</td>
<td>D.S.O.</td>
<td>9</td>
<td>01.39</td>
</tr>
<tr>
<td>15</td>
<td>115</td>
<td>14728</td>
<td>D.S.O.</td>
<td>7</td>
<td>54.87</td>
</tr>
<tr>
<td>16</td>
<td>115</td>
<td>14728</td>
<td>D.S.O.</td>
<td>11</td>
<td>23.88</td>
</tr>
<tr>
<td>17</td>
<td>115</td>
<td>21,050</td>
<td>D.S.O.</td>
<td>8</td>
<td>12.33</td>
</tr>
<tr>
<td>18</td>
<td>116</td>
<td>16292</td>
<td>D.S.O.</td>
<td>9</td>
<td>46.28</td>
</tr>
<tr>
<td>19</td>
<td>116</td>
<td>16292</td>
<td>D.S.O.</td>
<td>12</td>
<td>45.69</td>
</tr>
</tbody>
</table>

D.S.O. = Direct System Output. No statistics of lines spooled could be found at the end of job, but could be found out only while running S.M.F. for billing.

Compile Profile

The profiles to be processed by the 'Compile Profile' program. This program checks for the format errors and the incorrect use of the logical connectors 'OR, AND, AND NOT'. Incorrect profiles are skipped with appropriate error message. The skipping commences from the point of detection of the first error and subsequent profile is not checked. The terms in each of the correct profiles are entered into a term table with apt symbolic identifiers. The expressions are compiled into pseudo instructions using the logical operators as op-codes and addresses or terms in the term Table as operand. These are entered in Code Tables with appropriate profile identifiers. A file of Term Table and Code Tables with appropriate profile identifiers is created for all correct profile. A listing of all the profiles along with error messages for incorrect profiles is printed out. The profiles can be updated, added or deleted. Annexure 5 gives a sample profile listing.

Complice profile file is an input to the search program. This program is run as frequently as required.

Search

The search program is run once a fortnight. It operates on the files generated by com-
Table 4: Execution Time for the Search Phase

<table>
<thead>
<tr>
<th>Run No.</th>
<th>Data Base CAC-Vol. 84 Is. No.</th>
<th>No. of Profiles</th>
<th>No. of Expressions</th>
<th>No. of 'Code' instructions</th>
<th>No. of terms</th>
<th>No. of duplicate terms</th>
<th>No. of almost duplicate terms</th>
<th>No. of MARC records</th>
<th>No. of hits</th>
<th>Min Time</th>
<th>CPU Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>30</td>
<td>109</td>
<td>4681</td>
<td>1095</td>
<td>187</td>
<td>419</td>
<td>5407</td>
<td>1515</td>
<td>2</td>
<td>2.62</td>
</tr>
<tr>
<td>2</td>
<td>1&amp;2</td>
<td>7</td>
<td>18</td>
<td>632</td>
<td>174</td>
<td>2</td>
<td>8</td>
<td>12158</td>
<td>368</td>
<td>2</td>
<td>14.77</td>
</tr>
<tr>
<td>3</td>
<td>1&amp;2</td>
<td>33</td>
<td>112</td>
<td>5417</td>
<td>1263</td>
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<td>549</td>
<td>12158</td>
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<td>4</td>
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<td>148</td>
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<td>387</td>
<td>810</td>
<td>12158</td>
<td>4052</td>
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<td>40.98</td>
</tr>
<tr>
<td>5</td>
<td>3&amp;4</td>
<td>73</td>
<td>222</td>
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<td>2342</td>
<td>693</td>
<td>1462</td>
<td>13442</td>
<td>4895</td>
<td>8</td>
<td>11.24</td>
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<td>3&amp;4</td>
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<td>70</td>
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<td>310</td>
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<td>3126</td>
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<td>6937</td>
<td>4331</td>
<td>6</td>
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<td>9</td>
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<td>349</td>
<td>19327</td>
<td>4336</td>
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<td>3702</td>
<td>15473</td>
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<td>14669</td>
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<td>4397</td>
<td>15149</td>
<td>7364</td>
<td>18</td>
<td>14.87</td>
</tr>
<tr>
<td>13</td>
<td>15&amp;16</td>
<td>116</td>
<td>391</td>
<td>23524</td>
<td>5708</td>
<td>2184</td>
<td>4448</td>
<td>16537</td>
<td>8146</td>
<td>19</td>
<td>47.35</td>
</tr>
<tr>
<td>14</td>
<td>17&amp;18</td>
<td>118</td>
<td>407</td>
<td>24997</td>
<td>6024</td>
<td>2330</td>
<td>4687</td>
<td>14481</td>
<td>7914</td>
<td>18</td>
<td>35.42</td>
</tr>
</tbody>
</table>

Sort

The search program gives all the bits on a file called SDI ANS. This file is sorted by passing on the required parameters to the IBM utility program called SORT available in all OS. The bits are sorted by profile numbers, expression numbers etc. The execution times of the sort phase are given in Table 2 in the previous page.

Print

The Print program does the last job of SDI system viz. the printing on hard copy. This program takes the longest time as per the clock time. It puts each record in a predetermined format and prints in double column. Annexure 6 gives a sample SDI print out from the CHEM/SDI software. Print program requires special stationery and special carriage control tape. The input files are SDIANS, USERS ADDRESS, FEED BACK ADDRESS. The output are the SDI printouts and the statistical data card. Table 3 in the previous page gives the execution times of this program:

System's Performance

The execution time for each phase has been presented in the foregoing description. The overall performance and the computer time utilisation can be had from the monthly bills paid since March 1976. Table 5 gives the time actuals for producing a SDI printout:

The average time required to service a profile is 1 mt 03.73 secs. This average is calculated over the period March-May 1976 as February 1976 was the trial month.

Conclusions

We had presented the performance and execution times required for running CHEM/SDI service. The average computer time in terms of CPU time is 1 mt 06.69 sec. It must be stated that this time is largely dependent on the profiling work which falls under the domain of Search Editing. Proper search editing can reduce the time appreciably and vice-versa. From the view point of the computer operations it must be emphasised that an operator must be thoroughly familiar with not only the programs but also with the package. A specialised training is needed even for an experienced programmer. CAN/SDI software and India package is a powerful IR tool and should be used extensively on other data base like INIS, MEDLARS, IFS etc. It will be a waste of effort and time if an attempt is made to write a
Table 5: Time Actu als for Producing an SDI Printout

<table>
<thead>
<tr>
<th>Month</th>
<th>Total Runs</th>
<th>Cards Read</th>
<th>Lines Printed</th>
<th>Cards Punched</th>
<th>Charg. CPU</th>
<th>Profiles</th>
<th>Average CPU Time/Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb.</td>
<td>52</td>
<td>4610</td>
<td>24152</td>
<td>771</td>
<td>41 Mts.</td>
<td>15</td>
<td>2 Mts. 44 Secs. *</td>
</tr>
<tr>
<td>March</td>
<td>58</td>
<td>24063</td>
<td>188363</td>
<td>217</td>
<td>145 Mts</td>
<td>48</td>
<td>1 Mts. 30.64 Secs.</td>
</tr>
<tr>
<td>April</td>
<td>49</td>
<td>15277</td>
<td>158285</td>
<td>206</td>
<td>104 Mts</td>
<td>73</td>
<td>42.86 Secs.</td>
</tr>
<tr>
<td>May</td>
<td>39</td>
<td>14052</td>
<td>368874</td>
<td>29</td>
<td>229 Mts.</td>
<td>103</td>
<td>1 Mts. 6.69 Secs.</td>
</tr>
</tbody>
</table>

* Includes trial run.

search program for these databases even on an experimental basis. However, this effort should be diverted for developing a software for smaller machines. It will be economical to obtain computer version of CAN/SDI package and modify it to Indian environment. It is essential that this study coupled with costing may be continued at least for the duration of the project so that proper realistic estimates could be drawn in case India decides to go on its own.

Acknowledgements

Authors are indebted to Shri S. Parthasarathy and Prof. H. N. Mahabala for providing opportunities and facilities for conducting this study.
ANNEXURE 3

PROFILE INFORMATION

1. Name: Dr S K Chopra
2. Position: Principal Scientist
3. Institution: Cement Research Institute of India
4. Address: M-10 South Extension II
   New Delhi 110049
5. Topic (Please give a fairly detailed description of your field of interest, including any aspect not required):
   Use of industrial by-products in the manufacture of cement and cement products including concretes, ceramics, glass and allied products
6. Please give section nos. of Chemical Abstracts (listed on the reverse) in which the above topic usually occurs.
   43, 49, 53, 54, 55, 56, 57, 58, 59, and 60.
7. Keywords pertaining to the above topic (general terms, such as 'Metals' should be expanded to the particular metals in which you are interested).
   Fly ash; blast furnace slag; colliery spoil; China clay/waste; slate waste; pulverised fuel ash; by-product calcium sulphate; steel slag; metallurgical slags; lead-zinc slags; copper slag; tin slag; red mud; mine tailings; quarrying wastes; waste glass; furnace bottom ash; furnace clinker; incinerator ash; Tin mine tailings; fluor spar mine tailings; colliery shale; phosphogypsum; fluorogypsum; fluor anhydrite;
8. Please list citation of at least five titles of relevant papers relating to the above topic.
I am interested in Analytical chemistry (Inorganic and Organic), Physical Chemistry, Petroleum (Fossil Fuel) Chromatography, GC, Gas, Thin Layer, IR, UV, NMR, High Polymers, Air Pollution and Industrial Hygiene, Fatty Acids.

Pertinent references are:

ANNEXURE 5

DATE: JUN 24, 1976
P 1173 28x276 PROFILE  MALLIK

T 1173
T A ANALYSIS
T B DETERMINATION
T C ESTIMATION
T D EVALUATION
T E INFRARED
T F INFRARED
T G IR
T H ULTRAVIOLET
T J UV
T K POLAROGRAPHY
T L NMR
T M NUCLEAR MAGNETIC RESONANCE
T N GC
T P CHROMATOGRAPHY
T Q GAS
T R THIN LAYER
T S LIQUID
T T IDENTIFICATION
T W QUALITY CONTROL
T AA FERMENTATION
T AB GEL FILTRATION
T AC PETROLEUM
T AD FOSSIL FUEL
T AE HIGH POLYMER
T AF MACROMOLECULAR
T AG MACROMOLECULAR
T AH PLASTIC
T AJ RESIN
T AK RUBBER
T AL FIBRE
T AM NATURAL
T AN SYNTHETIC
T AT SURFACE COATING
T AQ ADHESIVE
T AR AIR POLLUTION
T AS INDUSTRIAL HYGIENE
T AT FATTY ACID
T AU CA:73*
T AW CA245*
T BA CA51*
T BB CA55*
T BC CA75*
T BD CA80*

EO1 C 99 (A|B-AP|AU) & ((AC|AD-AD) | (AK|AL|AM|AN)| (AP|AQ-AT|AW|BA|BB

EO1 116(BC|BD)

EO2 C 99 (A|B-AB|AU) & ((AC|AD-AD) | (AK|AL|AM|AN)| (AP|AQ-AT|AW|BA|BB

EO2 116(BC|BD)

EO3 C 99 (N|P-ST|AC|AT|AW|BA|BB) & (BC|BD)

EO3 1173