

CSEM Tribological Database: How to Organize Tribological Test Results

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Introduction

CSEM has a long history in tribology. Since 1976, tribometers have been developed, produced and commercialized. Besides the instrument-oriented activities, tribology itself has continuously conducted exercised in the laboratories. In about 20 years, data have been collected by testing on various test machines, but mainly on pin-on-disk tribometers. The amount of stored test results exceeds 5000. These data concern mainly the development of special liquid lubricants and of self-lubricating surfaces. However, industrial projects have also stimulated a very wide technological survey by means of comparative testing.

The CSEM Tribology Service Center possesses a very interesting package of tribological data, because most of them have been

obtained on similar test machines. They can therefore be readily compared. However the storage on data sheets renders difficult the efficient exploitation of the huge amount of work accumulated.

Computerized data bases are nowadays accessible to any personal computer and allow to elegantly store this kind of data. There already exists several tribological data bases^{1, 2, 3}. After some contacts and discussions, it was decided to create our own structure for the following reasons: existing structures have been found to be either too specific to a definite type of tribological product to be able to receive our data, or too general to efficiently store data collected on pin-on-disc type tribometers.

Technical choices

The CSEM data base has been programmed in Microsoft Access, which is a relational type of data base program. This software has a very programmer-friendly interface. Furthermore, it is possible to create tools that may be used by untrained people. There might be some limitations at the level of multi-user connections. However we assume that this kind of data base can not

be used easily by every body. To be efficient, and without errors in interpretation, it should be exploited by tribology specialists. In these conditions, it is not expected and even foreseen that a large number of simultaneous accesses will be necessary.

Structure

The choice of the organization of the data is related to the kind of information one wants to extract. Taking into account the two main fields of development in technologies and materials on which the data to be stored are based, much attention has been paid to the description of the liquid lubricants and of the sample coatings. The main tables with their respective fields are listed hereafter.

In order to be able to make meaningful comparison between different materials it has been judged essential to have a hierarchical classification of them. The presented material classification has been created from the compilation of various existing structures, in view of the tribological properties of these materials. Test description data cover a restricted number of contact geometries and motion types, but give a complete description of the environment.

Primary keys (unique identifier of each record) and foreign keys (identifier of a record being stored in another table), used to create the relationships between the tables, are indicated by (PK) and (FK) respectively.

Tests

Test (PK)

Data sheet identifier

Date of test

Tribometer (FK)

Load

Speed

Radius of the track

Total number of revolutions

Static sample (FK)

Dynamic sample (FK)

Cleaning of the static sample

Cleaning the dynamic sample

Lubricant (FK)

Ambient pressure

Atmosphere composition

Relative humidity

Sample temperature

Initial friction coefficient

Minimum friction coefficient

Mean friction coefficient

Maximum friction coefficient

Wear rate of the static sample

Wear rate of the dynamic sample

Lifetime with $\mu < 0.1$

Lifetime with $\mu < 0.2$

Lifetime with $\mu < 0.3$

Lifetime with $\mu < 0.5$

Operator

Client

Comments

Samples

Sample (PK)

Sample identifier

Geometry

Dimension

Substrate material (FK)

Adhesion layer material (FK)

Adhesion layer thickness

Adhesion layer process (FK)

Main layer material (FK)

Main layer thickness

Main layer process (FK)

Surface coating material (FK)

Surface coating thickness

Surface coating process (FK)

Roughness

Hardness

Supplier (FK)

Comments

Lubricants

Lubricant (PK)

Designation
Base oil
Friction reducer
Friction modifier
Anti-wear
Extreme-pressure
Viscosity index improver
Anti-oxidant
Anti-rust
Metal-deactivator
Anti-foam
Detergent
Dispersant
Thickener
Other additive
Viscosity
Supplier (FK)
Comments

Remark

For each additive, it corresponds a field for its concentration. It has been skipped in this list.

Materials

Material (PK)
Common name
Other designation
Principal component
Secondary component
Ternary component
Material subclass (FK)
Comments

Materials classification

Ceramics

Borides
Carbides
Carbonitrides
Glasses
Nitrides
Oxides
Silicon
Other ceramics

Composites

Ceramic matrices

Metal matrices
Polymer matrices
Other composites

Iron and steels

Carbon/Low-alloy steels
Cast irons
Stainless steels
Tool steels
Special steels

Non-ferrous alloys

Aluminium alloys
Cobalt alloys
Copper alloys
Nickel alloys
Precious alloys
Pure metals
Refractory metals/Alloys
Specific alloys
Titanium alloys
Other non-ferrous alloys

Polymers

Elastomers
Thermoplastics
Thermosettings
Other polymers

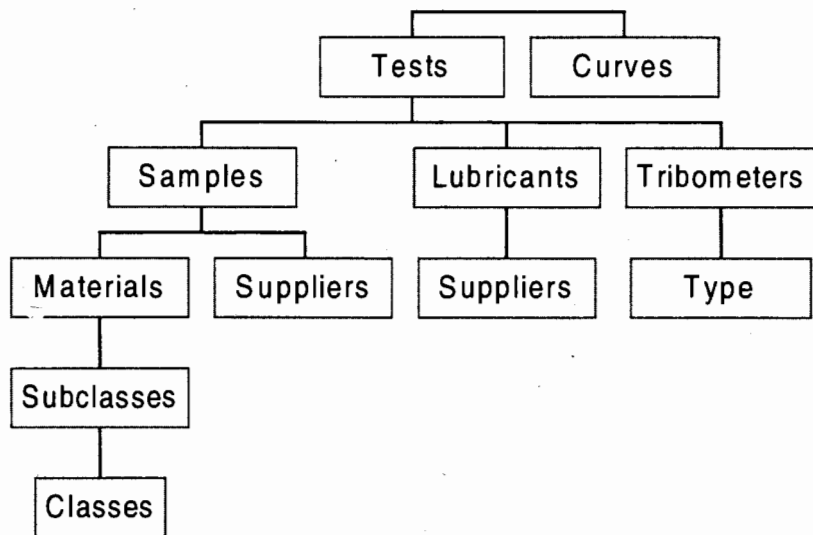
Solid lubricants

Carbon based
Chalconides
Halogenides
Salts
Other solid lubricants

Superalloys

Cobalt-based
Nickel-base
Other superalloys

Table relationships



Conclusions

We have developed a structure for storing pin-on-disk test data and results. The structure shown may store much more information than the existing data sheets usually contain. The detailed description of liquid lubricants and coatings is the key to make this tool useful for the developer of such tribological products and also for a quick first check in case of an actual industrial problem.

Furthermore, the possibility of storing digitized measurement curves has already been implemented. This function has been foreseen to completely integrate the data processing chain. In the near future, it will be possible to transfer automatically to the data base the data collected on a computerized data acquisition system. This complete system will give a greater efficiency in generating, processing and storing data from tribological tests.

Finally, the defined structure is open and it is possible to extend it to store test results from other types of tribometers or other instruments.

References

- 1 M. Woydt, 19th IRG-OECD, Tokyo 1995
- 2 Tribolog, HEF, Andrezieux-Bouthéon, France
- 3 Tribodata, Dr. Tillwich, Horb, Germany