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HTR-M1 Turbine Results Data Provided on CD-Rom

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Adding value through knowledge

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Previous issues of this document shall be destroyed or marked **SUPERSEDED**

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Summary

This report provides a position statement on the delivery of HTR-M & M1 Turbine test results data to the Web based Database Mat-DB. The turbine results produced by CEA for the HTR-M1 Project have been provided to JRC on CD-ROM for inclusion on the Mat-DB database, which is part of the ODIN suite of JRC. Data from JRC tests have been provided directly.

This constitutes Deliverable D5 of the HTR-M1 Project.

1 Introduction

This report provides a position statement on the delivery of HTR-M & M1 Turbine test results data to the Mat-DB Database.

This constitutes Deliverable D5 of the HTR-M1 Project.

2 Activities of HTR-M1 Work package 1 on Turbine Materials

Reliable material property data is a key requirement in the development of HTR and VHTR technology. An understanding of material behaviour plus materials data obtained under representative reactor operating conditions is required for the main HTR components in order to assess safety and feasibility. Work Package 1 of the HTR-M1 project deals with the selection and development of materials data for the most highly loaded areas of the turbine (direct cycle).

The activities of Work package 1 of HTR-M1 extends the materials platform established in HTR-M [Ref. 1] on turbine materials by considering the effects of creep damage and environment focussing on intermediate creep duration testing. The activities cover the following areas of work:

- Results and assessment of tests performed at CEA on materials identified in HTR-M for the turbine blade and disc materials at remaining short and at medium times plus ageing tests
- Results and assessment of tests performed at JRC on the above treated turbine blade and disc materials to asses the effects of corrosion (carburisation/ decarburisation)

It was agreed as part of the tasks of HTR-M & M1 to develop the requirements for an HTR database and that the results of HTR-M & M1 would eventually be housed on the MAT-DB facility and thereby made available for the HTR-M & M1 partnership.

3 Database provisions for HTR-M & M1

The database activities within these two projects are summarised in Ref 1 & 2 and can be described as follows:

HTR-M Activities:

An important objective of the HTR-M project was the development of a database of materials information for the key components. This would cover Vessel Materials, High Temperature materials and graphites & c-composites.

For the turbine materials these are to cover those most likely to provide acceptable performance for the discs and blades.

Aspects such as composition, manufacturing information, test and design data plus environment were included in the design of spreadsheets. The materials property database includes code data where available, and raw data for analysis. Significant amounts of a data exist for these alloys and the main focus is on comparisons and assembling relevant design data.

The overall layout proposed for the database covers material designation, provisions, products & parts, test data and design property information. The design property information is an important output from the database as its expected to help drive future decisions on information needs and tests. Design needs plus omissions and shortage of test data are expected to be the basis on which the database will be built up and expanded.

A document dealing with the management and transfer of the information provided by the HTR-M partners has been issued, also a series of datasheets compiled and loaded onto the SINTER website and on to the CD-Rom of the project. The relevant supporting technical documents relating to this task have been issued. Subsequent information from the HTR-M1 project (see below) and future European VHTR activities will be added to the core of data provided by the HTR-M project.

HTR-M1 Activities:

These represent follow-on activities form HTR-M in the form of an update of the developed data within the prescribed formats plus the transfer of test results to JRC for inclusion in the Web based Mat-DB facility (see section 4).

4 Availability of Mat-DB

The Alloys-DB system (or Mat-DB of ODIN) developed at JRC as a web based system for high alloy was investigated as a potential means for housing the information on the web in the long term to allow remote partner access and to maintain secure transfer of information between the different partners and countries. A PC version of Alloys-DB was provided in order to assess its suitability and agreements were made to allow access by all the HTR-M participants. Following a series of presentations and discussions on the potential benefits/ drawbacks of Alloys-DB at progress meetings it was agreed that the transfer and assembling of the available database of information would be done in two stages:

1. Collection of the information on to a CD-Rom via the co-ordinator.*

2. Provision of the information to JRC for transfer on to the Alloys-DB system.

HTR relevant data previously established on the Alloys-DB system by JRC and FZJ would also be available to the project.

The method of transfer as proposed by JRC has been presented and is described in Appendix A.

* Note: Subsequently all minutes, presentations, reports and available data have been assembled on to an HTR-M & M1 CD Rom and distributed one to each partner

5 Tests performed within HTR-M & M1

The tests performed within HTR-M & HTR-M1 on turbine disc and blade materials are summarised in Tables 1 to 3.

These include tests in air on as received materials plus tests under pre-aged and carburised and de-carburized treated conditions as follows:

- As received with ageing heat treatment – I
- Decarburised – II
- Carburised – III
- After the carburisation or decarburisation heat treatment – I(mod)

It was agreed that these are to be applied to both the HTR-M and HTR-M1 tests and to be carried out on both the turbine disc and blade materials. Originally it was proposed to carry out the tests for conditions I and I(mod) at CEA in air, and conditions II and III at JRC in argon. After some discussion it was decided that all tests are to be carried out in air. Ageing would be carried out in an argon atmosphere, using oversized blanks.

6 Data transfer to Mat-DB

The data transfer on Turbine Materials is carried out as follows:

Tests in air carried out by CEA (HTR-M & M1):
Transferred to JRC (H Over) by CEA(R. Couturier) via CD-Rom - completed

Tests under carburised & de-carburised conditions at JRC (HTR-M & M1):-
Transferred to Mat-DB directly by JRC. - (N Taylor) – in progress

Other data to be transferred as follows:

Vessel Materials – from JRC and NRG

Graphite Materials - from NRG

7 Conclusions

This report provides a position statement on the delivery of HTR-M & M1 Turbine test results data to the Mat-DB Database. The results of the HTR-M1 Project are to be stored on the Mat-DB database which is part of the ODIN suite of JRC.

The information on turbine materials to be transferred directly to JRC for inclusion in the database has been outlined.

This constitutes Deliverable D5 of the HTR-M1 Project.

8 References

[1] D. Buckthorpe
HTR-M Final Technical Rep[ort for HTR-M Project
HTR-M 04/12 P 0 0 105

Table 1 HTR-M Turbine Material Test Matrix

Test Matrix for Udimet 720

Test / n° of specimens	T (°C)	I	I_{mod}	II	III
Tensile	20 650 700 750	2 2 2 2	2 2 2 2		
Creep ~400 MPa (3000h) ~500 MPa (1000h)	750	4	4	2	2
LCF (3 De)	650	4	6	10	

Test Matrix for blade Alloys (IN 792 DS & CM 247 LC DS*)

Test / n° of specimens	T (°C)	I	I_{mod}	II	III
Tensile	20 750 800 850	1 1 1 1	1 1 1 1		
Creep x MPa (3000h) y MPa (1000h) z MPa (5-10 kHr)	850	2 2 2	2 2 2	2 2 2	2 2 2

Table 2 HTRM1 Turbine Material Test Matrix

CM 247 at 850^{o}C:

Test/no of specimens	T (°C)	I	I_{mod}	II	III
TENSILE	20 750 800 850	1 1 1 1	1 1 1 1		
CREEP X Mpa (3000 h) Y Mpa (1000 h) Z Mpa (5-10 Kh)	850	2 2 2	2 2 2	2 2 2	2 2 2

x., y, z : stress level to be defined to attain the desired rupture time.

For IN 792 DS aged up to 8000 H at 850°C:

Test	T (°C)	I	I_{mod}	II	III
TENSILE	20 800 850	1 1 1			
CREEP **x MPa (1000h)** **y MPa (3000h)**	850	3		4	4

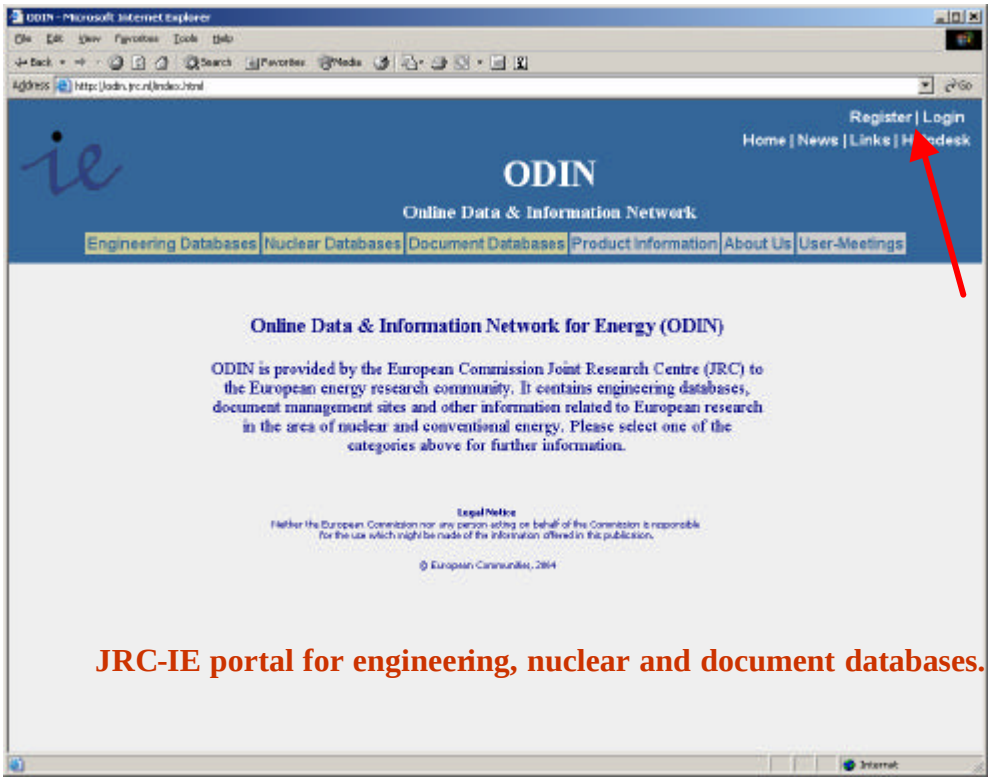
x and y: stress level to be defined to attain the desired rupture time.

Table 3 Test Matrix for U 720 Carburised test specimens

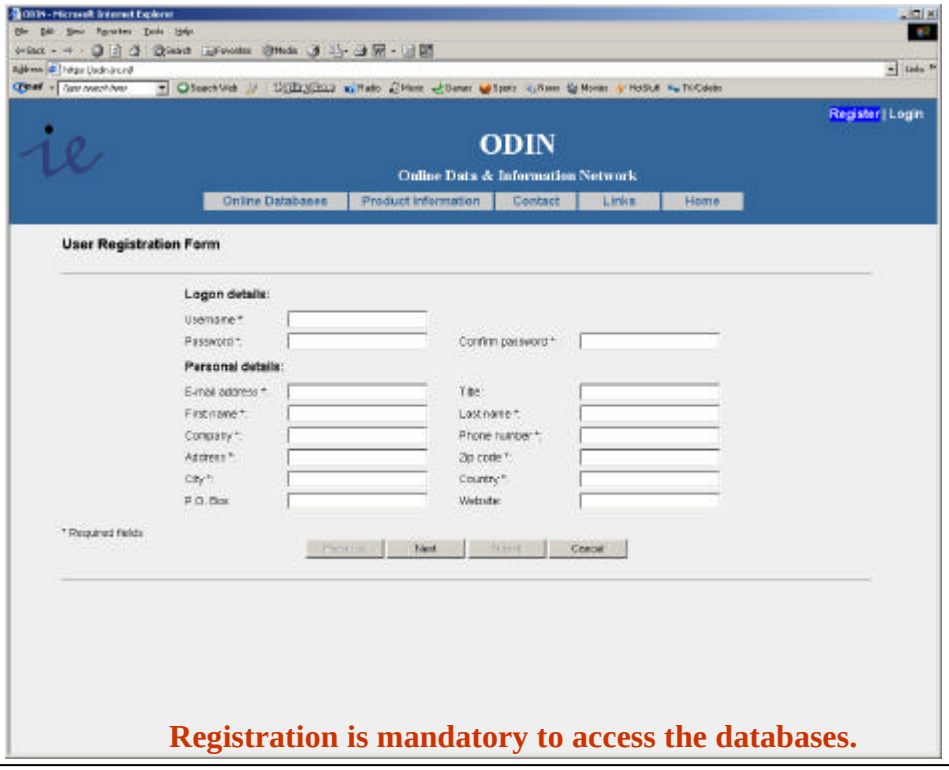
Specimen id.	state	T (°C)	de/dt (10^{-3}/s)	t_{cycle} (s)	e_{max} (%)	e_{min} (%)
U1	**III**	**650**	**1**	**19.0**	**1.0**	**0.05**
U2	**III**	**650**	**1**	**13.3**	**0.7**	**0.035**
U3 (polished)	**III**	**650**	**1**	**15.2**	**0.8**	**0.04**
U4 (dummy)	**I**	**Temperature profile calibration**				
U5	**III**	**650**	**1**	**11.4**	**0.6**	**0.03**
U6 (polished)	**III**	**650**	**1**	**19.0**	**1.0**	**0.05**
U7 (polished)	**III**	**650**	**1**	**13.3**	**0.7**	**0.035**
U8	**I**	**650**	**1**	**19.0**	**1.0**	**0.05**

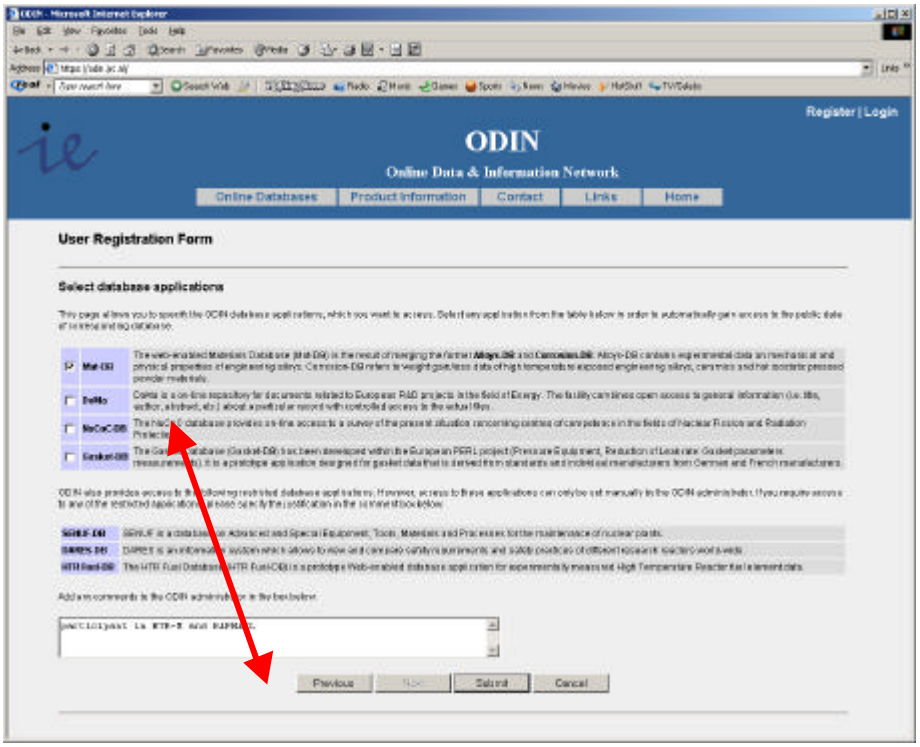
Appendix A - Access of HTR-M & M1 and Raphael properties data within the Web-enabled Mat-DB

1. Register on the JRC Petten ODIN website:https://odin.jrc.nl

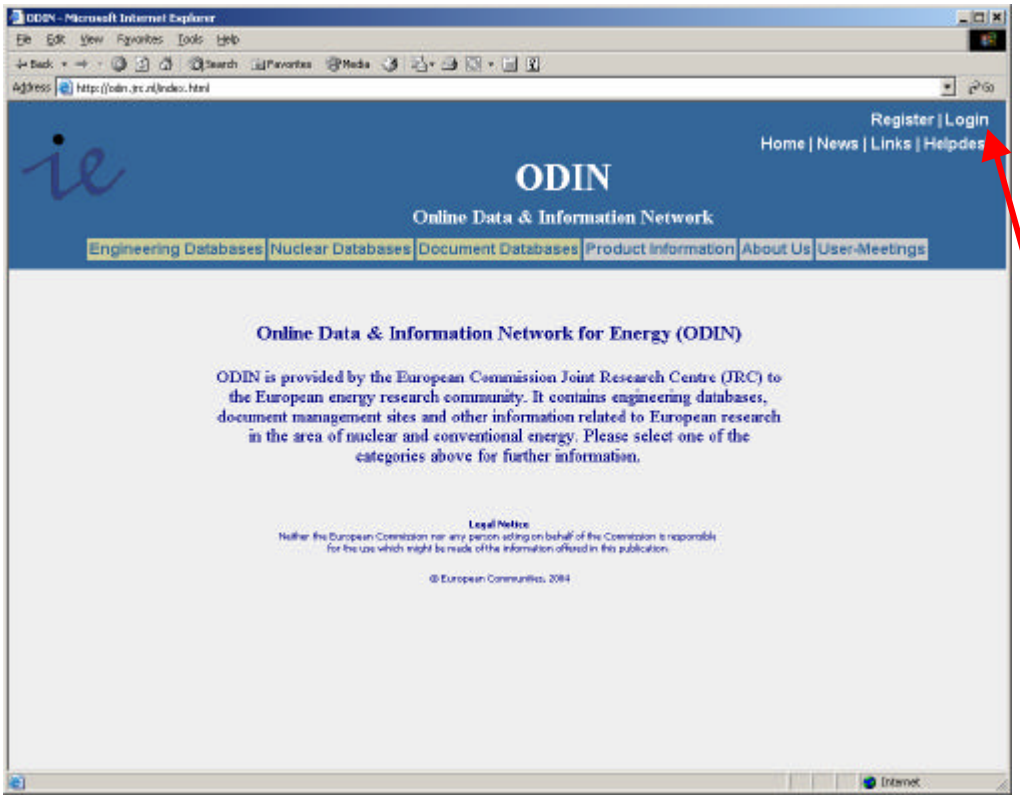


2. Select Mat-DB access and mention in the comments the involvement in HTR-M and/or RAPHAEL

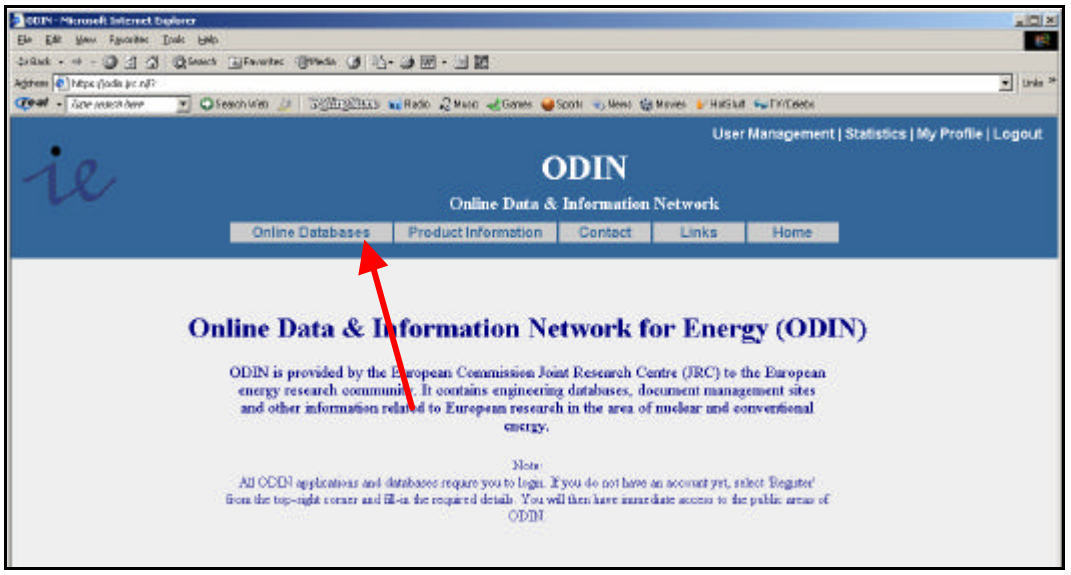




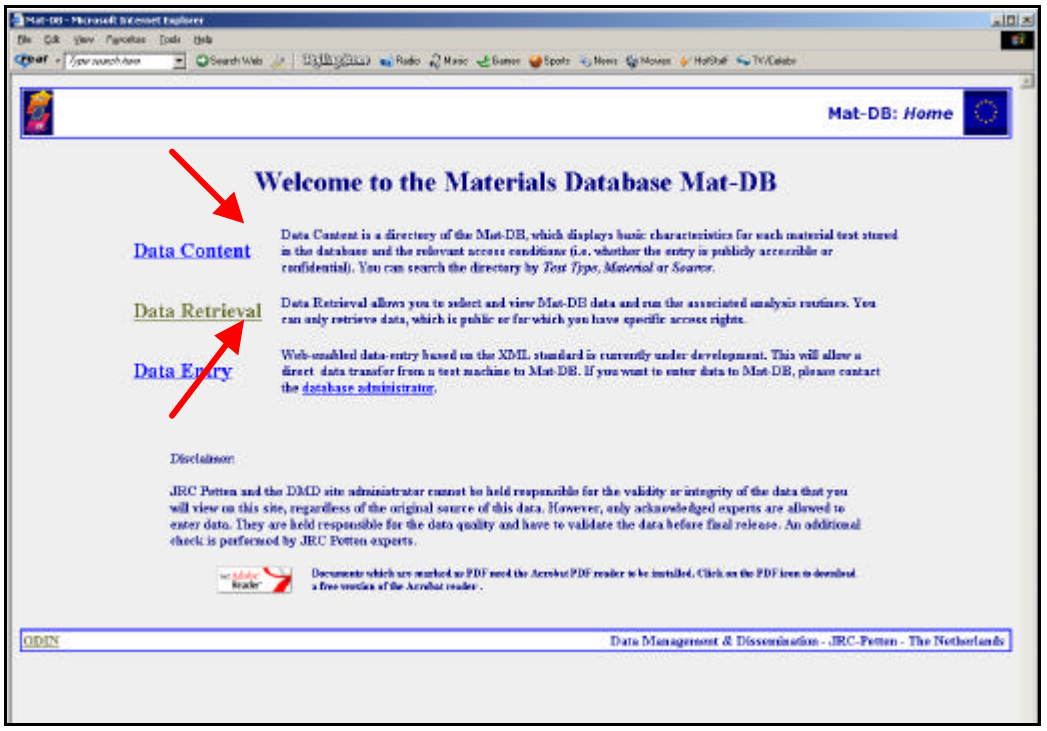
3. After registration you may login have automatic access to a small public data set within Mat-DB, access to **validated** HTR-M and/or RAPHAEL data is given after consultation and confirmation of the project responsible (after ~1 day).



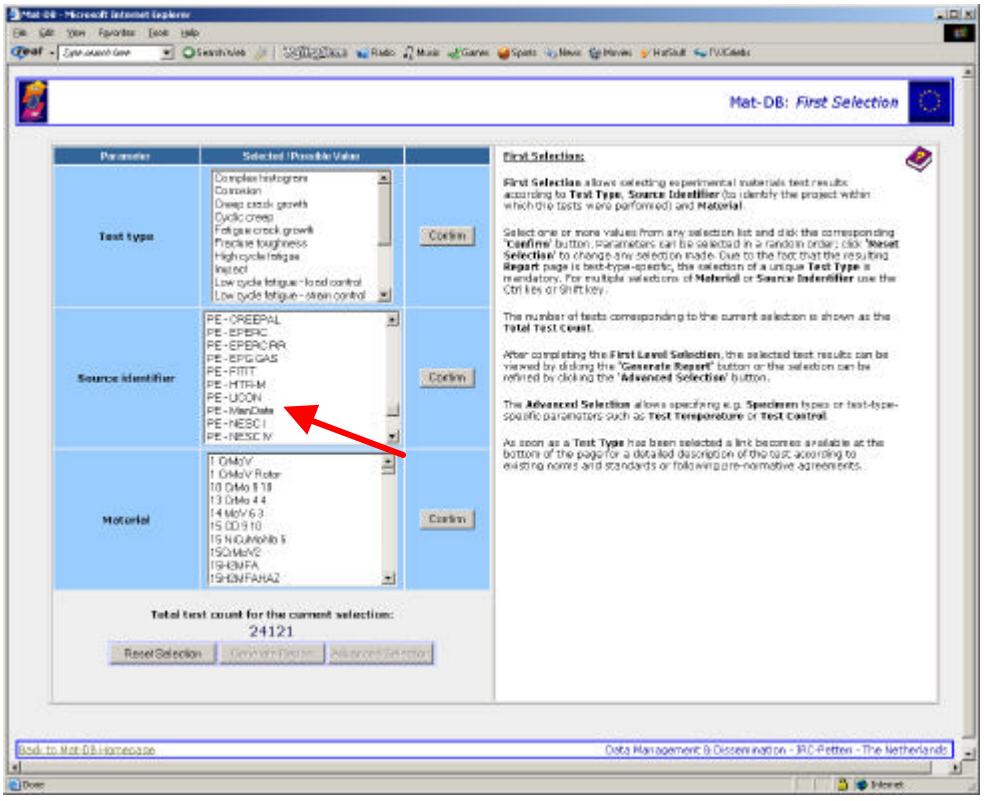
4. To access HTR-M and/or RAPHAEL click **On-line Databases** and then on Mat-DB



5. You can get an overview over the whole Mat-DB **Data Content** and especially over your account by clicking data content.



6. Clicking **Data Retrieval** you can select HTR-M data under the source identifier PE – HTR-M and later on RAPHAEL data under the source identifier PE – RAPHAEL



7. Refer to the help instructions to generate a report of your favored data. You can first continue the first selection with Advanced Selection and information about the chosen test type by clicking the PDF link.