MITSUBISHI POWER

LOOKING FOR TRACES

LABORATORY FOR MATERIAL SCIENCE AND FAILURE ANALYSIS

MOVE THE WORLD FORWARD MITSUBISHI HEAVY INDUSTRIES GROUP

MITSUBISHI POWER EUROPE

A 100-year track record in power plants, efficient products, a highly motivated workforce and a parent company of real strength to support us – that is Mitsubishi Power Europe. The energy plant constructor designs and builds thermal power plants and thanks to its references ranks amongst the market and technology leaders.

The company supplies key components such as utility steam generators, environmental engineering systems, turbines and coal grinding equipment. It provides low-cost service solutions and develops green technologies, for instance, in the biomass and energy storage fields. Mitsubishi Power Europe relies on state-of-the-art, environmentally compatible and efficient plants. As such, the company – with its head offices in Duisburg and around 1,700 employees – plays a prime role in securing a cost-effective supply of electricity on its markets.

Left:
The Spittelau waste-to-energy power plant (Austria)

Right:
The Bandirma combined-cycle power plant (Turkey)

THE MITSUBISHI POWER EUROPE LABORATORY

The scanning electron microscope sheds light on the matter – even the most minute traces become clearly visible when magnified 100,000 times.

This is only one of several techniques employed to determine causes of failures, product flaws, welding defects or for analyzing chemical compositions. The staff in the Mitsubishi Power Europe laboratory are experts in material science and chemical analysis and they make use of the most up-to-date equipment. They examine and analyze fossil fuels, determine, for example, the calorific value and grindability of various coal types and look for trace elements in combustion residues (in slag and ashes, for instance). Their aim is to both improve combustion and, at the same time, cut back on environmental pollution. This can be achieved, for example, by optimizing the design of coal mills and burners for the various fuel types.

MAIN EXPERTISE AND SERVICES

Our specialists carry out damage analyses and remaining service life investigations – something involving the examination of hundreds of material specimens every year. They check on processability and ensure that any newly developed materials are suitable for future power plant generations.

That is why close collaboration with those involved in projects / design work and with commissioning engineers is something quite natural for the laboratory's staff.

The Mitsubishi Power Europe Laboratory provides services allocated in three main fields of expertise: Material Science, Failure Analysis and Chemical Analysis. These complementary fields comprise various investigation techniques and analytical methods ensuring a unique and efficient service to our customers.

MAIN FIELDS OF SERVICES AND EXPERTISE OF THE MITSUBISHI POWER EUROPE LABORATORY

- Chemical Analysis
- Material Science
- Failure Analysis

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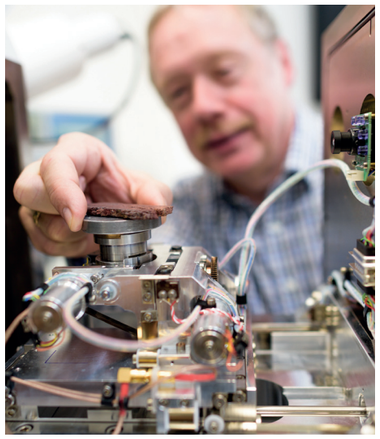
MATERIAL SCIENCE

General issues and tasks related to materials of power and environmental engineering components or with a general mechanical engineering background represent a main area of operations of the Mitsubishi Power Europe Laboratory.



Hardness, toughness, tensile strength are some of the crucial material properties for an efficient design.

Modern constructions and machines rely on the properties of the materials employed. Corrosion, oxidation, creep, fatigue and wear behavior are, for instance, important material properties which have to be assessed and understood for a successful and efficient design.

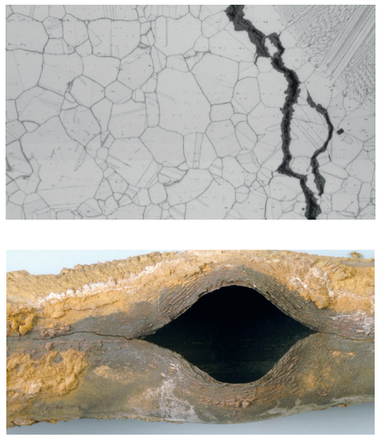
The Material Science services of the Mitsubishi Power Europe Laboratory provide materials investigations combined with experienced and qualified consulting services.

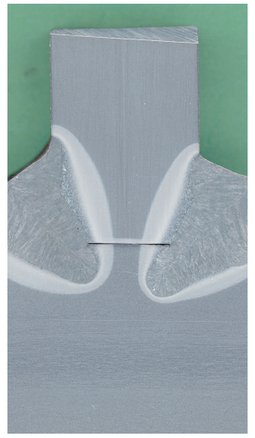
PRIMARILY THIS FIELD COMPRISES THE FOLLOWING SERVICES:

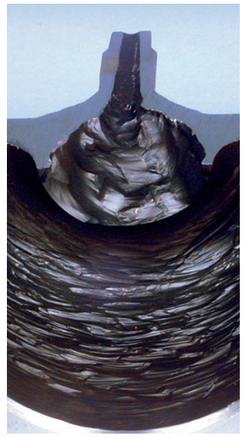
- Materials testing and investigations
- Production monitoring
- Qualification of production processes
- Specific material investigations for new technologies
- Research and development activities
- Consulting services
- Life time assessment related to corrosive or high temperature environments
- Remaining life analyses

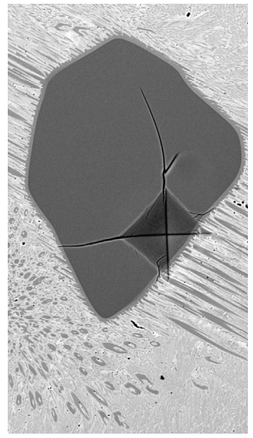
FAILURE ANALYSIS

Failure analysis services comprise the investigation of damaged metallic components focusing on identifying the root cause for a failure.









Examples of failures or defects of metallic components ranging from the macro to the micro-scale as documented from stereo, light and scanning electron microscopes.

New design solutions or unforeseen operating conditions are what often lead to damage and failure of components and machines. The Failure Analysis services of the Mitsubishi Power Europe Laboratory combine an experienced team with material related know-how with the expertise of chemists. All means required to determine the cause of damage or failures are employed and specific tests to simulate the damage on a smaller scale can be performed. This enables the possible root causes to be clearly identified.

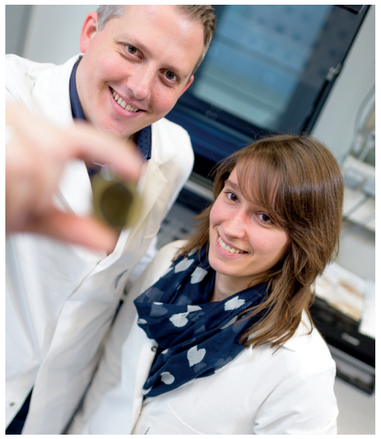
Understanding the causes of damage and failures minimizes the risks and avoids the repetition of the same mistakes.

THIS FIELD COMPRISES THE FOLLOWING SERVICES:

- Investigation of damaged metallic components
- Evaluation of findings and possible root causes
- Supporting legal cases through consulting services
- Exchange with other experts in working groups or technical associations

CHEMICAL ANALYSIS

General issues and analytical tasks from power and environmental engineering represent the third main field of expertise of the Mitsubishi Power Europe Laboratory. This includes the examination of different types of fuels and their residues after combustion. Our experts also analyze system waters, deposits, residues and flue gas cleaning products.



Some of the analytical methods employed by the Chemical Analysis team of the Mitsubishi Power Europe Laboratory.

THIS FIELD COMPRISES THE FOLLOWING SERVICES:

- Chemical and physical properties of solid and liquid fuels including particle size distribution, grindability, ignition point, heating value, melting characteristics of ashes, trace element determination and viscosity
- Environmental and process analyses of power plants products such as ashes, slags, deposits, corrosion products, limestone, gypsum, slurries and eluates
- Examination and analysis of system waters and aqueous solutions
- Metal analyses through OES and corrosion tests in high temperature water or controlled environments

X-RAY FLUORESCENCE ANALYSIS

General analysis of chemical composition of inorganic, mineral and metallic samples

ANALYSIS VIA ION CHROMATOGRAPHY

Analysis of water samples for cation and anion concentrations

OPTICAL EMISSION SPECTROMETRY

Determination of exact chemical composition of metallic samples
(Fe, Ni, Co, Al, Cu or Ti based materials)

SCANNING ELECTRON MICROSCOPY

SEM incl. wavelength and energy dispersive X-ray analysis and EBSD (Electron Backscattered Diffraction)

LIST OF ANALYTICAL METHODS

The services described above rely on various analytical methods. The most commonly employed methods at the Mitsubishi Power Europe Laboratory are listed below with reference to the standard or work instruction applicable. In keeping with customer needs or specific requirements other methods not listed below might be applied.

Ash fusion properties Ash fusion properties	DIN 51730
Grindability according to Hardgrove (hard coal)	DIN 51742
Grindability according to Hardgrove (lignite)	Mitsubishi Power Europe work instruction
YGP abrasion index of coal	ISO 12900
Wear test according to DB	Mitsubishi Power Europe work instruction
Higher and lower heating value	DIN 51900-1 and -3
Sample preparation	DIN 51701-3 and -4
Moisture content / analysis moisture	DIN 51718
Ash content	DIN 51719
Volatiles	DIN 51720
Total sulphur	DIN 51724-1
Sulphide and disulphide sulphur	DIN 51724-2
Chlorine content	DIN 51727
Fluorine content	DIN 51723
Carbon / Hydrogen / Nitrogen	DIN 51732
Swelling index	DIN 51741
Total sulphur and chlorine determination	Mitsubishi Power Europe work instruction according to DIN 51724-1 & 51727
Carbonate carbon dioxide	DIN 51726
Determination of chemical composition of fuel ash X-Ray Fluorescence Analysis	DIN 51729-10
Bulk density	DIN 51705
Free calcium oxide	DIN EN 451-1
Fibrous xylite according to Süß	Mitsubishi Power Europe work instruction
Ignition point according to Jentzsch	Mitsubishi Power Europe work instruction
Salt content of hard coals	Mitsubishi Power Europe work instruction
Grain size analysis	DIN 66165-1
Grain size distribution > 20 µm by sieve analysis	DIN 22019-1
Representation of the grain size distribution in the RRSB diagram	DIN 66145
Determination of Viscosity Temperature Relation	DIN 51563
Determination of density	DIN 51757
Testing of petroleum: incineration / oxide ash	DIN 51460-2
Determination of the content of asphaltenes	DIN 51595
Determination of total contamination in middle distillates	DIN EN 12662

Determination of the carbon residue: Conradson method	DIN 51551-1
Determination of flash point	DIN EN ISO 13736
Degree of whiteness	Mitsubishi Power Europe work instruction
Preparation of samples for the analyses (dissolution method)	DIN 22022-1
Determination of pH-Value	DIN EN ISO 10523
Determination of electrical conductivity	DIN EN 27888
Determination of solid state density	DIN 66137-1
German standard methods for the examination of water, waste water and sludge; parameters characterizing effects and substances (group H); determination of total dry residue, filtrate dry residue and residue on ignition (H 1)	DIN 38409-1
Potassium permanganate consumption	VGB-B-401
Determination of total and composite alkalinity	DIN EN ISO 9963-1
German standard methods for the examination of water, waste water and sludge; parameters characterizing effects and substances (group H); determination of filterable matter and the residue on ignition (H 2)	DIN 38409-2
German standard methods for the examination of water, waste water and sludge; cations (group E)	DIN 38406
Determination of dissolved anions by liquid chromatography of ions – Part 1: Determination of bromide, chloride, fluoride, nitrate, nitrite, phosphate and sulfate	DIN EN ISO 10304-1
Determination of dissolved Li+, Na+, NH_4+, K+, Ca^2+, Mg^2+ using ion chromatography	DIN EN ISO 14911
Silica acid	Mitsubishi Power Europe work instruction
Gypsum	VGB M 701
Fly ash for concrete – Part 1: Definition, specifications and conformity criteria	DIN EN 450-1
Colorimetry	DIN 5033
Viscometry – Measurement of viscosity by means of the rolling ball viscometer by Höppler	DIN 53015
Reactivity of limestone	VGB M 701
Testing of mineral oil hydrocarbons and solvents; determination of water content according to Karl Fischer; direct method	DIN 51777
Dissolved oxygen in water measured by membrane covered amperometric sensors	DIN EN ISO 5814
Optical emission spectrometry (OES)	DIN 51008
X-ray spectrometry – X-ray emission- and X-ray fluorescence analysis (XRF)	DIN 51418
Intergranular corrosion test according to Strauss et. al.	DIN 3651-2

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