

Annual report of Steel Institute **VDEh 2013**

Summary of main topics of technical-scientific joint cooperation and work



VDEh Steel Institute VDEh

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The Stahl-Zentrum in Düsseldorf

The Steel Institute VDEh and the German Steel Federation, with their subsidiaries and associated companies, form the Stahl-Zentrum in Düsseldorf as legally autonomous units. Competences in the production and use of the material steel nationally, in Europe and internationally are consolidated under this umbrella organisation.

The aim of the **Steel Institute VDEh**, founded as a technical association for metallurgy as long ago as 1860, is to encourage the technical, technical-economic and scientific collaboration of engineers in the further development of processes for iron and steel production and the material steel itself. Whereby the Steel Institute VDEh has driven forward joint research and the exchange of experiences in national, European and international joint work. The **German Steel Federation (WV Stahl)** is the economic policy association of the steel industry in Germany with the aim of effectively representing the steel industry to politicians, business and society.





The Steel Institute VDEh

The competences of the Steel Institute VDEh include joint technical, technical-economical and scientific work, the initiation and support of research and development work, work in the field of process technology, steel applications, and participation in the creation of standards and regulations. The results of the joint work are generally published in technical journals and books. The Steel Institute VDEh maintains a comprehensive collection of technical information and Europe's largest public library on the topic of steel. Further education measures and modern information media contribute towards giving young talents the necessary knowledge and providing active members of companies of the steel industry – as well as the supplier and user industries – with the latest knowledge on the further development of steel technology, further processing, and the application of steel materials

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Petra Fiebig Tel.: +49 (0)211 6707-481 e-mail: petra.fiebig@vdeh.de The Steel Institute VDEh has always been based in Düsseldorf. After many decades as a national technical-scientific steel association it increasingly developed into an organisation active throughout Europe. European steel companies have become members of the Institute and are an important constituent of the technical-scientific joint work. Whereby close contact is sought with suppliers as well as with the numerous customers and users of steel. Thanks to good international contacts, this joint work leads to a worldwide alignment.

This steel network offers the unique opportunity to ensure the position of steel as an excellent construction material.

The Steel Institute VDEh – steel cluster network

The steel cluster network is supported by the joint work of the steel producers with suppliers, as well as with the further processors and end-customers of the steel industry. The numerous value-creation chains of the material steel – from production to commodities and their recycling – are reflected in the work of the Committees. Whereby topics such as the conservation of resources, reduction of emissions, optimisation of processes, design of materials and components, as well as the use of modern simulation technology form the central focus of the work.

The Committees of the Steel Institute VDEh

The Committee system is a central component of the Institute's work. It is integrated in an overall competence of the VDEh that also comprises the areas of research, further education, publication, etc. The basic mission is a technical-scientific and technical-economic positioning of the sector, for which feedback from the member companies within the framework of committee work is indispensable. Committees are important points of contact with the member companies. Management of the business of the Committees and consolidation of sector competences complement one another.

The working structure of the Steel Institute VDEh is as follows in 2013 $\,$









together with Wirtschaftsvereinigung Stahl

International Societies of Steel Institutes (ISSI)

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In 2013, the annual Director Conference organised and chaired by Steel Institute VDEh and held before the STAHL annual event, took place at the Stahl-Zentrum with 14 participants from 11 nations. Participants are the Managing Directors of the technical-scientific steel associations of other countries worldwide, gathered in the European Steel Societies Confederation (ESIC) and in the umbrella organisation the International Societies of Steel Institutes (ISSI).

The meeting serves to co-ordinate Association/Institute activities and allow collaboration regarding the organisation of international steel congresses and conferences.

www.issisteel.org

Technical-scientific collaboration

The Steel Institute VDEh is the competent service provider regarding joint technical-scientific work for the member companies. The companies also profit from the dense network between the VDEh and the organisations in the Stahl-Zentrum, as well as with national and international institutions. Whereby the VDEh drives forward the joint work in the Committees, which reflect the technological value-creation chain for steel. The VDEh promotes the transfer of knowledge by organising important conferences and congresses, as well as via the Steel Academy. The technical information services also contribute towards this. The organisations of the Stahl-Zentrum actively involved in **R&D and innovation**s collaborate closely.

Europe is playing an increasingly important role: representatives of European steel producers and plant constructors are active on numerous Committees. In a European comparison, the Steel Institute VDEh already has many unique selling points regarding its technical-scientific competences along the steel production chain. Building upon this, the aim is to further develop the Steel Institute VDEh into a successful service provider for joint technical-scientific work in Europe – to the benefit of the member works and the material steel, and as a contact for EUROFER.

The "Steel Institute VDEh 2020" concept aims to exploit the intensive processing of **cross-sectional topics** to enhance its competences, drive forward expansion of the profita-

Priorities



ble Steel Academy, and reorganise the co-ordination and management of research in the Stahl-Zentrum in order to strengthen joint research in the European context.

As a partner of Boston Consulting Group (BCG), the VDEh contributed its technical-scientific expertise to the study "Steel's Contribution to a Low-Carbon Europe 2050", which was commissioned by EUROFER and published in June 2013. The European idea was also evident regarding events: the "European Steel Technology and Application Days – ESTAD" international conference was established in tandem with several European sister organisations. Its content will cover the entire steel value-creation chain including steel materials and their application, it will be a European equivalent to the major conferences in the NAFTA area and Asia, and it will present the high technological competence of the steel industry in Europe. The first ESTAD took place in Paris on the 7 - 8 April 2014 and the second ESTAD will be held in Düsseldorf on 15 to 19 June 2015 (parallel to METEC), and then every two years – alternating between a variety of European locations and Dusseldorf (within the METEC framework).

Formulate common strategic R&D targets	Enhance raw materials and energy efficiency	Lightweight and multimaterial design
Prepare cross-sectional topics with European relevance	Develop CO ₂ abatement and avoiding technologies (BCG / VDEh study)	Further develop and qualify high-strength steels
Further develop measures for sustainability	Broaden basis of raw materials (quality)	Develop steel applications for urban areas and energy technology

The **Committees** of the Technology Department deal with the joint technical-scientific work in all areas of steel production – from raw materials; through the production stages of coking plants, sinter plants, blast furnaces, direct and smelting reduction plants, oxygen and electric steelworks, secondary metallurgy and continuous casting, forming technology to produce flat and long products, forges and cold drawn steel mills; to the properties of the material steel and its applications. Whereby the technical-scientific committees co-operate closely with the Research Associ-

ation for Steel Application, the research facilities in the Stahl-Zentrum, organisations promoting young talent, further education establishments, the Library and the Stahleisen Publishing House.

April 2013 marked the completion of a study entitled **"Steel's Contribution to a Low-Carbon Europe 2050"**, which The Boston Consulting Group and the Steel Institute VDEh have been working on together since November 2012 and which was commissioned by Eurofer. It was produced in response to the EU's target of reducing industrial CO_2 emissions by more than 80 per cent by 2050. The aim of the study was to provide an objective assessment of the contribution that the steel industry in the EU 27, and the material steel itself, makes towards reducing CO_2 emissions. The assessment of differing scenarios that also took into account a radical restructuring of the production process and the application of CCUS (CO_2 capture, usage or storage) confirms that – from a technical point of view – the EU's demands are quite simply impossible for the European steel industry to achieve.

Metallurgy

The main topics examined in the **Coke Committee** were the organisational structure in the participating coke plants, as well as the causes of graphite formation in coke ovens and



examines CO₂ reduction potentials

in the steel Industry



A rare view into the coke oven

A working group began examining the cross-sectional topic of **increased efficiency and reduced CO**₂ **emissions along the steel value-added chain** in 2013. The main areas focused on were measures for reducing CO₂ and increasing efficiency in the process and production stages of steel production, energy management, achieving CO₂ savings through the use of steel, and the use of CO₂ from the process gases for new products. The latter topic provides the option of cross-sector work.

measures undertaken. In the discussion on personnel organisation it was possible to elucidate the differing structures and the outsourcing of services to external companies, as well as the various maintenance strategies.



KBS Kokereibetriebsgesellschaft Schwelgern GmbH · Major supplier to ThyssenKrupp Steel Europe: the Schwelgern coke plant of Pruna in Duisburg has the world's largest coking chambers

The activities in the **Blast Furnace Committee** included the topics of cleaning waste gas from sinter plants using bag filters, the development of iron ore qualities, a burden distribution strategy at the blast furnace top, the relining of blast furnace Hamborn 9 (at ThyssenKrupp Steel Europe), hearth wear and hearth repair on blast furnaces, and the injection of titanium oxide carriers into the blast furnace to form a wear-preventing scaffold in the blast furnace hearth. During a joint plenary meeting of the Coke Committee and the Blast Furnace Committee in Düsseldorf the experts also discussed requirements regarding the quality of blast furnace.



AG der Dillinger Hüttenwerke · It's the mix that matters: a conveyor belt at ROGESA in Dillingen piles up a bedding yard composed of fine ores, additives and solid fuels for the sintering process



The **Steelworks Committee** focused on the quality of charge materials and operating resources, radioactivity in scrap and systems for monitoring radioactivity, as well as the possibilities for monitoring scrap burdens.

voestalpine AG · Scrap gripper with integrated radioactivity sensors, as well as GPS tracking, permits identification of contaminated radioactive scrap



Iron and Steel Institute of Japan 40 Japanese and 40 Europeans participated in the symposium in Osaka

The six-day joint symposium on metallurgical fundamentals – involving the Iron and Steel Institute of Japan (ISIJ), Sweden's Jernkontoret and the Steel Institute VDEh – took place in Japan in April 2013. A total of 80 metallurgists participated in this exchange: 40 Japanese, 20 Scandinavians and 20 members of the **Committee on Metallurgical Fundamentals**. The two-day seminar in Osaka focused on new developments in metallurgy with particular attention to environment technology. Five Japanese works were visited after the seminar.

The 26th Spectrometer Conference was held in Friedrichshafen in 2013 in addition to the "normal" committee work of the **Committee for Chemical Analysis**, which

The technical field of the **Energy Committee** focused on the latest developments for increasing energy efficiency and decreasing CO_2 emissions, particularly the reduction of gas losses through the use of the most modern regenerative combustion technology and the optimisation of burners and furnaces. The exchange of experiences also concentrated on increasing the blast furnace gas utilisation capacity and on the effect of varying gas compositions on the industry. The European Union's Eco-design Directive was also discussed. The Committee was involved in the development of European standards for the determination of greenhouse gas emissions, particularly the sector-specific standard for the steel industry.

Another aspect examined was the evaluation of energy statistics within the framework of the steel industry's CO_2 monitoring. If the success of the steel industry's voluntary commitment to CO_2 emission reduction were based on crude steel production, then the industry reduced its specific CO_2 emissions by 15.0 percent from 1.594 tonnes CO_2 /tonne crude steel in 1990 to 1.356 tonnes CO_2 /tonne crude steel in 2012. However, the balance is much better if the development of CO_2 emissions is measured on the basis of finished steel products. From this perspective, the specific CO_2 emissions decreased by 20.9 percent between 1990 and 2012. This reduction is thus within the target area of the industry's



AG der Dillinger Hüttenwerke · Determining sulphur content in fuels

is divided into two technical committees. The conference provided an opportunity to learn about the state-of-the-art of spectrometry technology in research and science and its use in harsh everyday industrial work. The Committee also examined, among other things, technical aspects of the energy transition as well as the subject of environmental analysis and organic spectroscopy – principally in terms of industrial use.

commitment of 22 percent. A precision landing could hardly be expected given the long observation period, the number and variety of the companies involved, and the uncertainties of forecasting when the agreement was originally drawn up. The industry's voluntary commitment can therefore be considered as fulfilled.



Specific primary energy-related CO_2 emissions of the steel industry in Germany fell by 15 per cent between 1990 and 2012 when based on crude steel production, and almost 21 per cent when based on finished steel products

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AG der Dillinger Hüttenwerke · Environmentally friendly technology in the steel industry: these pipes in the Dillingen blast furnace top gas power station transport the excess blast furnace gases to steam turbines. The power station thus achieves a performance of 90 megawatt and reduces the loss of waste gas



Georgsmarienhütte GmbH Detail of reducing and sizing block

Forming technology

The quality of material surfaces has become increasingly important for many steel applications in recent years and this is also reflected in the topics dealt with in the **Committee for Flat Products**. Automatic surface inspection systems (SIS) have become established as a recognised process for quality assurance and for the support of decisionmaking regarding the evaluation of strip steel. Hot strip mills and coating plants are generally equipped with automatic SIS. The automatic surface inspection of hot slabs – which allows a very early intervention in quality control – is relatively new. The main potential of SIS lies in the appropriate further evaluation of data for quality control. The aim is to improve knowledge on the creation of surface defects and their development along the process chain, and to optimise processes by means of root cause analyses.

Zinc-magnesium-aluminium is a new hot-dip coating for fine sheet steels and offers considerably better corrosion prevention. Coating thicknesses can be reduced or components can be protected for considerably longer. Its use is environmen-

tally friendly and conserves resources. Up to now, the new coating has mainly been applied in the construction industry and in architecture. As a result of its good forming properties, however, these coatings also offer major potentials for use in automotive construction. A working group in the Flat Products Committee has specially examined the performance range of European zinc-magnesium-aluminium alloys for use in vehicles and summarised its findings for publication.

Rolling is now generally characterised by a high level of automation. Measurement and control systems are integrated, and powerful process computers are used. The **Committee for Long Products** examined the coupling of quality and process data. Complete and reliable material tracking can be ensured by means of the complete de-

piction of material flow in an Enterprise Resource Planning (ERP) system. Economic advantages result from increased specific performance, improved yield, fewer mistakes and shorter downtimes, as well as greater process reliability with lower running costs.



Steel Institute VDEh · The 28-page brochure provides information on new zinc-magnesium-aluminium coatings especially for the automotive industry

Further efforts are also necessary in the **forging industry** in order to ensure and expand competitiveness. Processes for continuous improvement in the production of forged parts are aimed towards increasing plant efficiency whilst minimising material and energy consumption. They are characterised by step-by-step technological further developments in order to be able to provide customers with products with excellent material properties. Greater efficiency at power stations can be achieved if one can reach the temperature range above 700 °C, and nickel alloys, cobalt alloys and special steels are increasingly in demand. The Open Die Forging Committee therefore examined the requirements for producing nickelbased alloys. In the area of hammer forging, laser supported measurement technology for determining parameters and workpiece

dimensions is increasingly being linked with modern simulation technology. Cold drawn steel is characterised by its high demands regarding dimensional accuracy and surface finish. The **Cold Drawn Steel Committee** provides information for its members on new developments in inspection technology. Surface and internal defects can now be detected at higher inspection speeds and with improved detection sensitivity.

Plant technology

The difficult economic and political conditions facing the steel industry have also brought about a strategic realignment of plant technology. New technologies and qualified employees should assist in meeting the challenges of the future. The focus is on **product quality and plant avail-ability** with maximum efficiency. Steel companies have continued strategic projects to improve plant technology and environmental protection. The main emphases in the joint work were optimisation of maintenance activities and the comprehensive determination of cost-reduction potentials.

The 34th VDI/VDEh Forum on Maintenance took place at Daimler AG in Stuttgart under the motto **"Maintenance - Motor of Production"**. The main topics were the qualification of maintenance staff, modern software tools, and changed maintenance strategies in an altered economic environment. Maintenance experts from many sectors discussed the extent to which maintenance could be made more value-creating in 2025. Maintenance trends were described, future requirements regarding the qualifications of personnel were defined, and the technical equipment and organisation required for maintenance were specified in over 20 specialist presentations.

Materials/Applications

The **Materials Committee** examines the material steel and characterises its properties. The Committee represents the material-related interests of the steel companies externally so that the material steel can be increasingly and dependably used. For this purpose there are close connections to the further and final processing industries. The range of topics necessitates specific specialist committees and working groups to identify and further develop the property profiles of the steel grades examined and expand application potentials. This also ensures unambiguous material-technical discussions with steel processors and users.

During the testing of the long-term strength of heat-resistant steels and high-temperature materials the test temperature ranges are becoming increasingly blurred – so the two research associations (which have been in existence since 1949 and 1957) have combined to form the Research Association for Heat-Resistant Steels and High-Temperature Materials. Now experiments are jointly discussed and initiated, while results are jointly evaluated.

Aspects of energy efficiency must be considered as early as the project planning phase. The Plant Engineering Committee's **report entitled "Energy-Efficient Drive Systems for the Steel Indus-try"** has become a proven instrument for the systematic determination of energy-saving potentials because insufficient practical and literature-based information is available. Three more reports – systematic recommendations for action – are currently being prepared for the "Guidelines for Operational Practice" series:

- » Quality Assurance Measures for New Construction Projects
- » The Concept of the Digital Factory in the Steel Industry
- » Recommendations Regarding the Use of Condition Monitoring (CM) Systems.

A variety of specialist reports describe procedures for introducing energy management systems, certification measures, and operational experiences. Systematic **energy management** leads to decreased energy consumption, reduced energy costs and lower greenhouse gas emissions.



Saarschmiede GmbH Freiformschmiede · Blocks weighing up to 240 tonnes are formed at the open-die forge in Völklingen

Participation in European and international **standardisation** in the steel sector plays an important role. In addition, specific Stahl-Eisen-Werkstoff (SEW) and -Prüfblatter (SEP) (iron and steel material and test specification sheets) are published to meet any further requirements. SEP 1231 – Determination of Mechanical Properties of Joined Sheet Metal Materials in Tensile Tests at High Velocities – was completed. The sheet closes a testing gap. In many cases, the mechanical resilience of a joined structure differs from the properties of the individual components. And data on the behaviour of the connection points at high deformation velocities is needed, in particular, for assessing the crash safety of vehicles. Standards hitherto available contain no clear guidelines for tensile tests of joined components at high speeds.

Steel, as the pre-eminent construction material, is in increasing competition with other emerging materials and its performance must constantly expand. As part of the cross-cutting issue of **steel compared to other materials**, basis data are collected, components compared, research needs derived and talking points for steel developed.



SMS Siemag AG, Düsseldorf · Graphite electrodes melt scrap to make steel.

The results of joint work flow into specialist committee reports, specialist journals, as well as contributions to www.massiverleichtbau.de national, European and inter-



national specialist congresses. The results are also presented in summary during further education measures such as seminars or attended courses.

The arrangement of national and international events is another task of the Materials Committee. A workshop on surface inspection systems as measurement systems of the future brought steel and system producers together to discuss the state of the art and future potentials. Research ideas are followed up together with the customers' associations and the Research Association for Steel Application (FOSTA). "Two sectors – one aim: solid light construction in vehicles" is the central theme of an initiative in which a consortium of companies (now 24) in both sectors work on the potentials of solid-formed components for light construction in vehicles. The initiative wants to use material-, forming- and processing-related activities for light construc-



Alstom Power Systems Turbomachines Group · in Birr, Switzerland The steel gas turbine blade ensures high efficiency

tion to promote it to the public and derive research needs. The collaboration is managed by the Industrieverband Massivumformung (the German Association of the Solid Forming Industry) and the Materials Committee of the Steel Institute VDEh.

The Steel Academy

The Steel Academy is the education department of the Steel Institute VDEh and the leading provider of seminars on the metallurgy and material technology of steel. The Academy's programme covers the topics of raw materials, recycling, iron and steel production, forming, material technology, energy and the environment. The non-technical seminars cover business administration, management topics and intercultural training. The participants come from steel companies, the supplier and user industries, and plant manufacturers. The programme currently includes 39 seminars, of which 33 deal with technical aspects of the material steel. Events last from one day to four weeks. The Steel Academy always strives to further develop the seminar programme and to adapt it to current technical,



The 33rd Management Seminar at the Parkhotel Krefelder Hof is increasingly popular

economic and social challenges. Thus three new events were created in the areas of the environment and energy in 2013, examining the topics of energy efficiency, material cycle management and radioactivity. The Steel Academy collaborates with numerous universities, technical colleges and institutes (which often host the seminars) in order to ensure that the seminars maintain a high level. The roughly 200 trainers and speakers are experts from industry, research and development, as well as from universities and associations.

The first **English-language seminar**, The Electrical Engineering of Arc Furnaces, was introduced in 2000. Seven international events now take place regularly, and more are planned as part of the Europeanisation of the Steel Institute VDEh. Correspondingly, a quarter of seminar participants now come from abroad: during the last three years they have come from 22 European and 13 non-European countries.



Both the number of participants and the number of seminars held by the Steel Academy have risen continuously between 2009 and 2012; also 2013 was on the high level of 2012

Standardisation

The Steel Institute VDEh has been involved in the standardisation of steel products for over a hundred years. The offices of the **Normenausschuss Eisen und Stahl (FES)** (the Committee for Iron and Steel Standardisation) are associated with the VDEh regarding their organisation, financing and personnel. The FES specialists elaborate standards in the area of steel and iron according to the rules of the Deutsches Institut für Normung (DIN) (The German Institute for Standardisation). It represents German interests during worldwide and European standardisation in the area of steel and iron at the International Standards Organisation (ISO) and the European Standardisation Committee (CEN). The

Technological-scientific information

As a service provider, the Technical and Library Information Department (ITUB) of the Steel Institute VDEh makes efforts to meet the constantly changing conditions of today's information environment. The activities of the ITUB are primarily aligned towards the needs of the member companies and the personal members of the Steel Institute VDEh, whose questions make up about 90 per cent of enquiries. Simultaneously, however, the ITUB is also a public library and supports universities and specialist libraries, other teaching institutes, research facilities, commercial enterprises, students, historians, etc. With its specialist literature evaluation, the ITUB creates an overview of the literature published in a variety of forms. In terms of content, the entire area of steel is covered. All technical-scientific publications worldwide are considered. After reviewing, evaluation and assessment, the significant literature is published both in the Literaturschau Stahl + Eisen and in the literature database www.stahllit.com, which contains evaluated literature from 1980 onwards.



European standardisation work is principally carried out at the European Committee for Iron and Steel Standardisation (ECISS), which is part of the CEN. The committees and sub-committees of the FES are largely aligned on reflecting ECISS and ISO intentions and bear the responsibility for forming German opinion. The FES is responsible, in particular, for elaborating technical delivery conditions, dimensional, terminological and product-specific testing standards. The work is carried out in product-, steel- and/or application-based committees. Other groups are concerned with the classification, nomenclature, and numbering of steels, as well as sampling and general technical delivery conditions.



From 1540 till today: almost 160,000 publications fill 6,000 metres of shelving

The Steel Institute VDEh has been collecting information on steel-producing companies and their equipment worldwide since 1970. The internationally unique plant database **PLANTFACTS** now describes about 12,800 production plants in the steel industry in 110 countries. This information is used by members of the Steel Institute VDEh, as well as customers from other branches of business.

The **Library** obtains current literature as soon as possible. The total stock of volumes, proceedings and books now numbers about 160,000. The Library is the sole owner of

The Research Association for Steel Application

The **Research Association for Steel Application (FOS-TA)** finances and organises research projects in order to improve the use and application of steel, maintain its competitiveness, and open up new areas of application. These research projects are initiated, supported and funded in collaboration with steel producers and suppliers and carried out in networks consisting of industry and research facilities.

Projects focus on material behaviour, processing, transport technology, construction, and environmental technology. Whereby important cross-sectional tasks include simulation techniques, research involving the principles of sustainability, and the conversion of results into standards and standardisation. As members, leading companies in Europe's steel and steel-supplier industries, research institutes and engineering bureaux participate in funding both FOSTA's management of research as well as its research projects. They are involved in the selection of topics, the carrying out of research projects, and the implementation of research results.

FOSTA obtains funding from the Steel Application Research Foundation, from Germany's federal and state economic and research ministries, and from the EU's Research Fund for Coal and Steel (RFCS). This is supplemented by funds from research partners and by industry participation. This enables the implementation of current research topics in joint **research projects**. 103 research projects were still running in 2013, with a total volume of about EUR 48.3 million. The funding, both from donors as well as from industry itself, reaches the research centres carrying out the work in the form of assistance, services and cash payments.

Current topics involve sustainability in steel (light) construction, application-oriented simulation in bonding and welding technology, and reducing the weight of moving masses (forged steels), the use of high-strength steels in offshore wind farms and in steel and machine construction, (ultra-) high-strength steels in the automotive industry and agricultural machinery, as well as materials and processes for facade construction.

As a result of several FOSTA research projects, the Deutsche Institut für Bautechnik (the German civil engineering institute) has issued a National Technical Approval for the use of composite dowel strips to further optimise the transmission of shear forces in composite constructions. The apsome journals and conferences in Germany. Special importance is placed upon purchasing and collecting the so-called "grey literature", i.e. literature not published by publishers – such as research or congress reports, company publications and dissertations. The Library's stock is published in OPAC, the Library's online catalogue, with literature from as long ago as 1540: www.stahl- bibliothek.vdeh.de.



The crawler lattice boom crane can lift maximum loads of 3200 t

proval applies for dowel strips made of structural steel in grades S235 to S460 and used for superstructure work and bridge-building.

The **results** are presented to a broad specialist public from industry and science at events and colloquia. The following are worthy of special mention:

- » the 13th colloquium "Joint Research in Adhesive Bonding Technology" in Frankfurt-am-Main on 26 and 27 February 2013, with about 300 experts,
- » the 10th steel symposium "High-Strength Steel in Steel and Machine Construction" in Zweibrücken on 15 and 16 May 2013, with 170 participants, whereby approx. 85% were from the industry.

In addition, comprehensive **final reports**, news items on the internet and, twice a year, summaries in "FOSTA – Reports

from Application Research" are published on each completed project. FOSTA's final reports can now also be downloaded as PDF files at www.stahldaten.de (the internet address of the Steel Institute VDEh's steel database).

FOSTA organised the 13th "Stahl fliegt" (steel flies) competition for students. The concepts were presented at the Institute for Production Engineering and Forming Machines at the TU Darmstadt on 3 July 2013 and at the air show at the Messe Frankfurt-am-Main on 4 July 2013. 16 teams from seven universities competed. Three teams from Aachen, Bremen and Dortmund achieved virtually identical flight times of almost 20 seconds in this competition and were thus way ahead of the other participants – so three first places were awarded this year!

Stahleisen Publishing House

The Stahleisen Publishing House produces informative products covering the entire range of steel-related topics under the Stahleisen Communications brand. It follows two current trends: digital media and internationalisation. The three specialist journals – stahl und eisen, MPT (Metallurgical Plant and Technology) and stahlmarkt - are printed and also available as mobile tablet apps and e-papers on the internet. The new stahl und eisen INTERNATIONAL, for the worldwide market, is only published electronically (four issues per year). The English-language stahlmarkt European Edition focuses on the European market of steel distributors and service centres (four issues per year). For the first time a Turkish edition of MPT is also available. The book programme is also electronic: the popular Stahlfibel (which covers all aspects of steel production) appears as an e-book, available from major stockists (e.g. libreka.de) as a download (subject to a fee) and can be read on all common tablets and classic PCs. The material database StahlDat offers important research reports. SteelTV is increasingly producing videos in industrial quality.

Global and electronic: stahl und eisen INTERNATIONAL



Participants in the "Stahl fliegt 2013" competition



Efficient steelmaking Steel's contribution to a low-carbon world



Research at the Stahl-Zentrum



1) Legally autonomous organization

- organizationally assigned to the Materials/Applications Department.
- 2) having equal rights since 01.01.2014.

The Max Planck Institute for Iron Research (www.mpie.de) and the VDEh Institute for Applied Research (BFI) (www.bfi.de) publish their own activity reports.

The Steel Research Committee in the Steel Institute VDEh

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Tasks and objectives

Strategic orientation of R & D activities in the Stahl-Zentrum and in the steel industry

Identification of possible R & D priorities for the steel industry along the steel supply chain

Spokesperson for cooperative research towards politics, government and science

VDEh Institute for Applied Research (BFI)

The VDEh Institute for Applied Research (BFI) is a leading European research institute of application-focused R&D in the field of steelmaking technology. It provides the steel industry with toplevel research and development meeting the most demanding international standards. BFI's field of activities covers the entire steelmaking process chain, from charge materials to the final product. Core competences lie in the field of measuring technology, process engineering and process automation. BFI cooperates very closely with similar institutes all over Europe.

A total of 13 specialized departments, structured into three divisions (Energy and Resource Technology, Process Technology, Measuring Techniques and Automation), handle the Institute's work via a competence-based approach. Delivering plant-wide optimisation in terms of quality, resource and energy efficiency as well as operational cost-effectiveness is our foremost objective.

Individual research projects are conducted on measures to reduce energy demand and carbon emissions. This requires knowledge of the mass flows and usage rates in an integrated steelworks. To this end, a tool has been developed for recording and visualising energy flows and CO_2 emissions in order to evaluate the economic potential of utilising waste heat.

Further projects in this area focus on utilising CO_2 . In a cross-sectoral collaboration a technology is being developed which will result in a two-stage process for pyrolytic splitting of natural gas into hydrogen and carbon. CO_2 will then be combined with the hydrogen to form synthetic gas, a base material for the chemical industry. The remaining carbon is then to be used in the steel industry as a reducing agent.

In addition to the environment-specific topics, BFI works on optimising individual processes in the steelmaking value chain. This includes efforts to improve the strip casting process. In two-roll strip casting, the melt flows between two counter-rotating, chilled rolls and solidifies to a thin strip. A model test facility is operated for the purpose of simulating this strip casting process. It allows realistic mapping and simulation of the physical processes involved.



Visitors to the Open Day at the Stahl-Zentrum tested out the BFI's thermal imaging camera. It normally monitors the development of heat on industrial plants and detects temperature fluctuations of as little as 0.05°C.



Plexiglas model of a strip casting line at the BFI. The melt flows between two cooled counter-rotating rollers and sets to form a thin strip.

BFI also develops methods for improving process control. Together with several research and industry partners, the Institute is developing a new approach for information processing as a basis for throughprocess optimisation of production workflows. The key technology here is the use of software agents, allowing complex optimisation tasks

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to be solved in a highly flexible way in distributed control systems. The developed techniques will be implemented to test their performance in optimising, for example, the logistics in workflows from continuous casting to hot rolling to cooling.

In 2013 the work of **BFI Betriebstechnik GmbH (BT)** focused on developing a measurement system for BFI's flatness measurement tension roll. The first deliveries of this innovative solution to a licensee took place in autumn 2013. Development of a new innovative and expanded measurement technology for the BFI flatness measurement roll will also be completed soon. First deliveries are planned for early 2014. The measurement technology for BFI's flatness measurement rolls is BT's most successful product and is marketed to licensees of the BFI. BT has meanwhile successfully supplied almost 2000 such systems. BT handles the development, marketing and production of these components. After-sales service (e.g. repairs) and spare part deliveries are also guaranteed worldwide.



The rotary transmitter from BFI Betriebstechnik is used in almost 2000 applications worldwide.

Max-Planck-Institut für Eisenforschung (MPIE)

The Max-Planck-Institut für Eisenforschung (MPIE) experienced interesting changes in 2013. One of them is the establishment of a new department "Structure and Nano-/ Micromechanics of Materials" headed by Prof. Gerhard Dehm, an Austrian material scientist and new director at the MPIE. The new department has several aims which range from the development of experimental methods to perform quantitative nano-/micromechanical and tribological tests for complex and miniaturized materials to gaining an understanding of the underlying deformation mechanisms in order to establish material laws for local and global mechanical behaviour. This will allow the development of new nanostructured materials and high temperature intermetallics with superior mechanical properties. The research focus lies on micro- and nano-sized materials as they show a totally different behaviour compared to their bulk counterparts. The analysed dimensions are so small that defects in the materials correspond directly with the size of the sample. This results in exceptional material properties which then can be transferred to bulk materials. Special attention is paid to thin film systems such as metastable metallic films or brittle films on flexible substrates. Moreover, high temperature materials, complex steels and the assembly of ceramics and polymers with different kinds of metals play a central role. External collaborations already exist with research institutes and universities, especially in the field of advanced TEM, synchrotron radiation and micro-/nanomechanical testing. However, the scientists also cooperate with industry on basic research topics. In April, a research project on smallscale mechanics started within an industry-driven EU project developing reliable materials for the next generation of power semiconductor devices. Applications are possible in nano- and microelectronics e.g. for flexible and automotive electronics or in power engineering. Other application possibilities are found in the field of corrosion protection and the processing of surfaces as the assembly of ceramics and polymers with metals.



Microstructure of a perlitic steel analysed with the scanning transmission electron microscope (STEM) at the MPIE. With a tensile strength of about 7 Gigapascal, perlite is the most resistant material that can be mass produced.





Prof. Dr. Gerhard Dehm, new director at the MPIE.



Prof. Dr. Martin Stratmann, new president of the Max Planck Society

Prof. Dr. Martin Stratmann elected as president of the Max Planck Society

Another important change concerns **Prof. Dr. Martin Stratmann**, Director of the Interface Chemistry and Surface Engineering Department. He was elected as **new President of the Max Planck Society** for the presidential term 2014 - 2020 at the annual assembly on 6 June 2013. As one of the largest public-private partnerships in Germany, the MPIE functions as a role model for this transfer.

Grain structure of a high-manganese steel. After deformation, traces occur, affecting the proper- ties of the material.

The MPIE organized many lab tours through the institute for partners from research and industry as well as for pupils and students in 2013. Besides these events, the institute also was engaged at the Open Day on 12 July, which was organized at the Stahl-Zentrum. The visitors experienced the fascinating world of modern materials research at the MPIE in over 30 experiments and talks. The MPIE scientists presented their recent developments and insights in the areas of computer simulation, surface engineering, microstructure physics and nanome-chanics.

On 27 September 2013 the institute participated in the first **Night of Science in Düsseldorf**. The MPIE arranged three exhibits where the 10,000 visitors to the Night of Science could experience how fuel cells function, how computer simulations help in developing hip implants and how interface chemistry and surface engineering help to develop coatings used, for example, for corrosion protection in the automotive industry.



Amazement in the atom probe laboratory during the Open Day 2013.

The Night of Science in Düsseldorf is a European-wide event with 320 participating cities and 32 European countries within the framework of the so called Researchers' Night.

Activities in European research

At the European level, the Research Fund for Coal and Steel (RFCS), the 7th Framework Programme for Research (2007-2013) and the coming 8th Framework Programme "Horizon 2020" (2014 - 2020) are relevant for the research in the steel sector.

At the request of the EU Commission, the European Steel Technology Platform (ESTEP) has been established in 2004 to accompany the Framework Programme. ESTEP aims to influence calls for proposals, to identify research focuses, to support applications, to publish position and strategy papers and to advise on the new Framework Programme. The governance of ESTEP relies on a Steering Committee and a Support Group, which are supported by seven working groups including representatives of the steel industry sector. This structure is complemented by the Research Committee of EUROFER, whose tasks include the preparation, development and coordination of priorities for the European steel research.

Research Fund for Coal and Steel (RFCS)

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RFCS Technical Groups – German representatives

TGS1 – Ore agglomeration and Ironmaking Dr. H. B. Lüngen (C) (VDFh)		TGS6 – Physical metallurgy and design of new generic steel grades"	
Dr. U. Janhsen (M)	(TKSF)	Dr. Th. Evertz (G)	(SZMF)
Dr. G. Harp (G)	(BFI)	E. Wüstner (G)	(Saarstahl AG)
TGS2 – Steelmaking processes		TGS7 – Steel products and applications for automo-	
Dr. B. Kleimt (M)	(VDEh)	biles, packaging and home appliances	
Dr. H. Lachmund (G)	(Dillinger Hüttenwerke)	Dr. V. Flaxa (M)	(SZMF)
		Dr. HP. Schmitz (G)	(TKSE)
TGS3 – Casting			
S. Rödl (M)	(BFI)	TGS8 – Steel products and applications for building,	
Prof. KH. Tacke (G)	(Dillinger Hüttenwerke)	construction and industry	
		Prof. U. Kuhlmann	(Universität Stuttgart)
TGS4 – Hot and cold rolling processes		Dr. G. Knauf (G)	(SZMF)
U. Müller (M)	(BFI)		
H. Janssen (G)	(TKSE)	TGS9 – Factory-wide co issues	ontrol, social and environmental
TGS5 – Finishing and co	pating	Dr. J. Kroos (C)	(Salzgitter Flachstahl)
Dr. Th. Koll (M)	(SZMF)	Dr. M. Langer (G)	(ThyssenKrupp Nirosta)
Dr. B. Schuhmacher (M)	(DOC Dortmunder	Dr. Th. Orth (G)	(SZMF)
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European Steel Technology Platform (ESTEP)

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ESTEP – European Steel Technology Platform Working Groups (WG) – German Members

Steering Committee

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Mirror Group representatives Dirk Grabowski (BMWi)

Support Group

Hans Ferkel (Thyssen Krupp Steel Europe) Ralph Sievering (BFI)

Implementation Group

Rudolf Carl Meiler (Thyssen Krupp Steel Europe) Ralph Sievering (BFI)

Working Group 1: Profit through Innovation

Jens Kempken (SMS-Siemag) Harald Peters (BFI) Klaus Josef Peters (Thyssen Krupp Steel Europe)

Sub-group – Process Factory of the Future Norbert Goldenberg (Siemens) Harald Peters (BFI)

Working Group 2: Transport

Oliver Hoffmann (Thyssen Krupp Steel Europe) Wolfgang Bleck (RWTH Aachen) Stefanie Geisler (VDEh) Guido Grundmeier (Universität Paderborn) Gunther Roth (Saarstahl) Peter Urban (FKA Aachen)

Working Group 3: Construction

Eduardo Herrmann (Steinbeis Europa) Markus Kuhnhenne (RWTH Aachen) Gregor Nüsse (FOSTA) Gerhard Sedlacek (RWTH Aachen)

Working Group 4: Planet

Dieter Bettinger (Siemens) Uwe Fortkamp (IVL) Günter Harp (BFI) Matthias Kozariszczuk (BFI) Gunnar Still (Thyssen Krupp Steel Europe)

Working Group 5: People

Rudolf Carl Meiler (Thyssen Krupp Steel Europe) Wolfgang Bleck (RWTH Aachen) Veit Echterhoff (Thyssen Krupp Steel Europe) Goetz Hessling (RWTH Aachen) Martin Kunkel (WV Stahl) Martina Neuhäuser (Salzgitter AG) Antonious Schröder (Sozialforschungsstelle Dortmund)

Sub-group Health and Safety

Veit Echterhoff (Thyssen Krupp Steel Europe) Martin Kunkel (WV Stahl) Rudolf Carl Meiler (Thyssen Krupp Steel Europe) David Missfelder (Thyssen Krupp Steel Europe)

Working Group 6: Energy

Walter Bendik (SZMF) Susanne Hoeler (SZMF) Gerhard Knauf (SZMF) Marion Erdelen-Peppler (SZMF) Christian Schäf (Thyssen Krupp Steel Europe) Karl Hermann Tacke (Dillinger) Ulrike Zeislmair (V&M)

Working Group 7: Energy Efficient Steel Production Wolfgang Bender (BFI)

Peter Dahlmann (VDEh) Hans-Peter Domels (Thyssen Krupp Steel Europe) Jean-Theo Ghenda (VDEh) Juergen Hoffmann (Thyssen Krupp Steel Europe) /// Notes

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