refractories WORLDFORUM
Hot Topics
Manufacturing & Performance of High-Temperature Materials
NEWSLETTER 1/2011

1 **Prof. C. Mattheck**

1 **Thinking tools after nature - to be applied on refractory materials, designs and systems?**

Thinking Tools Modelled on Nature

A cliff line, the foot of a tree, a mammalian bone, washed-out areas of an iceberg, or the tree top sheared by wind can be described by the same contour as a torn-off scrap of paper. Three generally understandable thinking tools - shear quadrangles, tension triangles, and force cones - are sufficient to analyse structures in nature and engineering without the use of a computer and to prevent component damage by simple shape optimization. The new book "Denkwerkzeuge nach der Natur" (Thinking Tools Modelled on Nature) by Claus Mattheck presents these thinking tools in an understandable manner and provides an introduction to geometrical natural science.

"The secret of these common geometrical features lies in a universal shape that occurs in nature over and over again," explains *Prof. Mattheck*, Head of the Biomechanics Department at *Karlsruhe Institute of Technology (KIT)*. "It is exciting that this shape can be constructed with simple geometrical methods and applied immediately." Mattheck has developed three related thinking tools – shear quadrangles, tension triangles, and force cones – that allow for analysis of mechanical structures in nature and engineering without any computer and, hence, prevent component damage by simple shape optimization.

A screw thread having this universal shape has a much longer defect-free service life. Industry already uses Mattheck's universal shapes to optimize components within seconds with just a CAD mouse click, whereas computer methods developed earlier by Mattheck's team needed several hours or even days. In tree care and diagnosis, this universal shape explains the safety behaviour of trees in a way that was unimaginable in the past. The new thinking tools also help to identify the causes of damage. An angular crack in the corner of a room immediately tells us which wall is subsiding relative to the other. The new method can also be used in bone surgery and orthopaedics. The universal shape can be found in many bone contours.

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News on refractories WORLDFORUM 2011

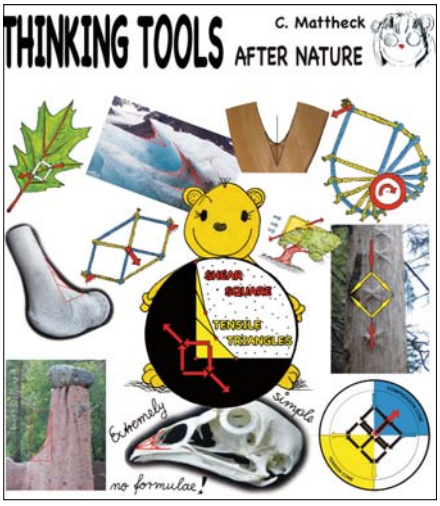
The international trade fair quartet **GIFA, METEC, Thermprocess** and **Newcast** will kick off in Düsseldorf/DE on 28 June 2011. Under the motto "The Bright World of Metals" the topics foundry technology, metallurgical technology, thermal process engineering and cast products will again be at the focus of global attention.

Companies that exhibit at GIFA, METEC, Thermprocess or Newcast can benefit from a special section in refractories WORLDFOROM issue 3/2011, which will be dedicated to this extraordinary quadrennially event.

Editorial Deadline:	13.04.2011
Advertising Deadline:	16.05.2011
Publication Date:	14.06.2011

www.refractories-worldforum.com; www.thermprocess.de; www.gifa.de; www.metec.de, www.newcast.de

sponsored by ECREF EUROPEAN CENTRE FOR REFRACTORIES



Thinking Tools After Nature

derstandable manner and provides an introduction to a "geometrical natural science" demonstrating common geometrical features in their natural variety. As this new instruction book for thinking on the basis of nature does not contain any formulas and mechanics is conveyed only by means of language and Mattheck's characteristic science cartoons, everybody, the pupil, arborist or craftsman, the architect and designer, the development engineer, physician, and the professor, is addressed. The book (236 pages, ISBN 978-3-923704-73-6) by Claus Mattheck has just been published and may be purchased from the Buchhandlung Hoser & Mende KG, Karlsruhe (e-mail: mende@schweitzer-online de) or from www.fabibook.de at a price of EUR 35.

We had the opportunity to speak to Claus Mattheck and ask him what engineers can learn from his findings with regard to improving ceramic and refractory material designs. Read what he told us as he summarized his technical expertise:

"I don't have all that much to do with ceramics. I know only that components under compressive loads are optimized by erosion. Ceramics should be designed for compressive loads..... A bit far-fetched, but perhaps it can be used for something.

Tension triangles are a universal shape in nature; they describe optimal shapes, be they dead or alive. In this connection, not only the shape of the tension-bearing notch, the most common cause of cracks, is optimized, but also compression-bearing structures, such as cliff lines and earth pyramids are "shaved" into their ideal shape by patient erosion.

Even optimized flow resistances – be it a wind-sheared tree or a water-smoothed pebble in a brook – provide this tension triangle contour; one for all – all for one. So there is no reason not to give ceramic components a manicure in order to optimize their shape, be it to deburr notches or to eliminate those useless lazy zones that don't bear any load in order to get the right shape. The formula-free concept of the tension triangles makes it a thinking tool for popular mechanics for everyman."

Some time ago, researchers at KIT developed programs that on the basis of evolutionary processes make components lighter and at the same time more stable. Here they are copying the action of scavenger cells in bones, which remove material from areas that are not subject to any especially strong forces. With this concept, in body-making, for example, streamlined components are formed that only possess bearing structures that are really needed, but no unnecessary ballast.

"Soft Kill Option" is the name of this software, which was often licensed out and helped improve more complex structures – like, for example, transverse control arms. This method too is replaced by Mattheck with his "force cone method". Technically usable solutions and methods such as shear quadrangles, tension triangles and force cones don't always have to be complicated providing you understand the principles of nature.

On **26 October 2011** Prof. Mattheck is holding a **seminar** on the topic **"Why everything breaks"** (component optimization without computers based on nature, fail-safe design: further operation of components with arrested cracks) at the Centre for Advanced Training at the KIT Karlsruhe. The seminar provides an introduction to the key failure mechanisms in commonly used materials and provides a guide to identifying weak points in components – that is to develop an eye for damage – and goes on to explain the optimization methods modelled on nature (*www.mattheck.de*).

Tips are given on material selection for trouble-free operation. Component optimization is demonstrated with reference to examples. The seminar is intended for designers and developers! New optimization methods that work on a purely graphic level, without special software are presented! New ways of thinking about fracture mechanics stop cracks!

RVM

news flash

USA

St. Louis Section / Refractory Ceramic Division Symposium 2011

The St. Louis Section and the Refractory Ceramics Division of *The American Ceramic Society* will sponsor the 47th Annual Symposium on the theme "Additives for Monolithics" on 23 and 24 March 2011. The meeting will be held in St. Louis, Missouri, at the Hilton St. Louis Airport Hotel.

Co-program chairs are *Dave Tucker* of *CE Minerals* and *Ben Markel* of *Resco Products*.

The Tabletop Expo format is the same as before with each vendor having a 6-foot table to display products and literature. The charge is USD 300, which will be used to cover the cost of the Expo Hall and provide an open two hour bar during the "Meet and Greet" for the attendees prior to dinner on Wednesday evening.

A partial list of exhibitors at this time includes: *Aluchem, BassTech International, Fibercon International*, and *Missouri S&T*. If you are interested in participating in the Tabletop Expo, contact:

Patty Smith (001-573-341-6265, psmith@mst.edu) or *Mary Reidmeyer* (maryrr@mst.edu, 001-573-341-7519).

A meeting of the ASTM International C-8 Committee on Refractories will be held on 22 March, before this joint St. Louis Section/RCD conference. Contact: *Kate McClung* at Tel. 001-610-832-9717 for more information on this meeting.

A block of rooms has been set aside for the evenings of 21 to 25 March 2011 at the Hilton (Tel. 001-314-426-5500). The rate is USD 99 for a single or double. To receive this rate, mention the St. Louis Section of The American Ceramic Society when making your reservation. All reservations must be received before 1 March 2011.

China

International Symposium on Refractories 2011

The 6th International Symposium on Refractories will be held on 18 to 21 October 2011 in Zhengzhou, Henan Province. It will be organized by the *Chinese Ceramic Society* and the *Chinese Society for Metals* under the topic "Refractories Serving Low Carbon Economy". Topics covered are:

- Refractories for the new energy industry
- Energy conservation, recycling and eco-friendly issues
- Refractories for the building materials industry
- Refractories for the metallurgical industry
- Refractories for other industries (lime, petrochemistry, incineration, ceramics, etc.)
- Refractory raw materials
- Equipment for, characterization and simulation of refractories
- Fundamentals and education

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France

EUROMAT 2011

The European Congress on Advanced Materials and Processes EUROMAT 2011 will be held on 12 to 15 September 2011 in Montpellier/FR. Euromat 2011 will aim at giving emphasis to the link between materials science and its applications, between academic research and industry. The Euromat 2011 conference will be jointly organized by two FEMS member societies: *Société Française de Métallurgie et de Matériaux* (SF2M) and the *Associazione Italiana di Metallurgia* (AIM).

Further information:
pascale.bridou@wanadoo.fr

Germany/EU

ECREF Refractory Seminars

The European Centre for Refractories – ECREF – will in future regularly arrange advanced study and training events within the framework of its education and training programme.

The seminar on "Refractories – Key Technology and its Applications" covers the basics of refractories, the technologies used in their production, and the industries in which they are applied. The seminar is designed to address the interests of prospective seminar participants, both "newcomers" to the refractories sector and others with specific related interests.

In the first part of this seminar the raw materials and the production of the different basic and acid refractory products (unshaped, shaped) are explained on the basis of their structure-properties correlations. At the same time the wear mechanisms under extreme conditions are discussed, highlighting the material-specific strengths and application limitations.

In the second part of the seminar, with reference to examples, 7 experts from different user industries (steel, foundry, cement, glass, and waste treatment) will explain the application criteria as well as the advantages and disadvantages of refractory systems solutions as exhibited in the specific application conditions. In addition, the key aspects of optimal handling in refractory engineering will be discussed. The seminar participants will be given the opportunity to discuss topical issues and typical applications with the experts from the different industries at any time. To this end, the schedule for the entire seminar is arranged to leave ample free time for the discussion of the participants' questions. The event will be held by the ECREF from 13 to 15 September 2011 at the Coblenz University of Applied Sciences, WesterwaldCampus, Höhr-Grenzhausen. Further details will be released shortly. Registration is already possible under: www.ecref.eu.

The seminar "Testing and Evaluation of Refractory Materials and Products" is designed to give an overview of the various measurement techniques to the practitioners in quality assurance and production technology at refractories production companies who are responsible for assessing the behaviour and application suitability of refractory raw materials and products. Standardized as well as specific measurement and test routines are explained in terms of the basic set-up and applied interactively together with the participants during the seminar. All the methods that have crystallized as being relevant during the more than 50 years of own experience will be presented. The date for the next seminar is 22 to 23 March 2011. Immediately registration is possible at: www.ecref.eu

Within the framework of this year's 54th International Colloquium on Refractories in Aachen from 19 to 20 October 2011, a technology symposium will also be arranged under the heading "Refractories for Non-metallurgical Applications". It is entitled "Moulding and Heat Treatment of Prefabricated Elements made from UHPC Concrete". UHPC stands for Ultra High Performance Concrete and the papers to be given at the symposium are to provide prefabricated element manufacturers from the concrete and refractories industries with the latest technological know-how concerning this class of materials. The objective is to give impetus to innovative joint developments and, if appropriate, industrial cooperation.

Russia

Magnezit Group in 2011 Begins Production of Magnesia Dry Mixes

Magnezit Group begins in 2011 production of magnesia dry mixes for working linings of tundishes of continuous casting machines at the plant *Magnezit-Torkret-Massy*, which is part of Satka production site of the company (Satka, Chelyabinsk region). Currently such masses are not produced in Russia.

Magnesia dry mixes are resistant to metal melts and slag and possess high thermal insulating properties thanks to optimal grain composition, modifiers and a complex binder. Mass composition is developed in such way that after finishing operation of the tundish and cooling of the lining to < 400 °C the working lining loses its construction strength and can easily be removed. The mixes are produced on the basis of densely sintered periclase powders which are produced by Magnezit Group in its production facilities in the Chelyabinsk region.

The new kind of products is intended for installation by "dry gunning". It enables to considerably improve basic engineering and economical performance of steel casting. Energy and refractories consumption is reduced as well as time of preparation of tundishes for casting. Thereby the quality of continuously cast billets is improved. The technological effectiveness of working lining operation of tundishes is improved as well as providing for accident-free mode of work of the vessel. In future it will be possible to reduce the number of tundishes. Such dry linings possess considerable advantages in comparison with traditional linings made by semi-dry or wet gunning by mixes of basic composition. Linings of tundishes with magnesia dry mixes are currently widely used in Europe. On the CIS territory such technology was introduced in 2009 and was successfully tested in the converter workshop of one of the biggest metallurgical plants. During the period of pilot and industrial-scale tests of tundishes there were no complaints concerning lining strength and natural gas consumption lowered during the first half year of the new technology applied by 1,8 Mm^3. Supplier of the magnesia dry mixes is in this project the company *Dalmond Feuerfest Siegburg GmbH & Co.*/DE (part of Magnezit Group). The project of producing dry mixes in Russia on the basis of the Satka production site is an example of production cooperation of the plants of the Magnezite Group. Using its own scientific and technological potential as well as raw material possibilities of the plants Magnezit Group optimizes recourses for developments and production of high quality products with the aim of satisfying ever increasing requirements of customers.

Magnezit Group runs the complete production cycle from mining of raw materials up to engineering and operational servicing. The company is 100 % provided for raw materials which makes it possible to produce more than 1000 grades of different products. The structure of the company includes 15 plants in Russia, China, Slovakia and Germany.

United Arab Emirates

The Aluminium Industry in the Gulf Countries

Investments into the Gulf's aluminium industry are currently estimated at around USD 30 billion and could reach as much as USD 55 billion by 2020 due to up-coming smelter expansions and new projects. A fully-integrated aluminium industrial complex being built as a joint venture between *Alcoa* and *Saudi Arabian Mining Co. (Ma'aden)* alone involves a capital investment of approximately USD 10,5 billion.

More foreign investors are looking to the Gulf for aluminium business due to its inexpensive gas stocks and strategic geographic location, with Europe already sourcing around 6 % of its aluminium demand from the region. The UAE and Saudi Arabia rank among the Gulf's two biggest aluminium markets. Smelting operations managed by *Dubai Aluminium Company Ltd. (DUBAL)* and *Emirates Aluminium* in Abu Dhabi produce around 1,8 Mt/a of aluminium or 40 % of total annual Middle Eastern production.

IMPRINT

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news flash

ALUMINIUM Dubai 2011, the premier exhibition for aluminium products, technologies and investments in the Middle East, serving as an investment catalyst,runs from 9 to11 May 2011 at the Dubai International Convention and Exhibition Centre (DICEC).

Australia

Flooding Impacts Supply of Aluminium from Boyne Smelters

Rio Tinto Alcan gave notice to its affected customers of a force majeure event impacting the supply of aluminium from *Boyne Smelters Ltd.* near Gladstone as a result of the severe flooding across Queensland.

The floods have cut road and rail access between Gladstone and Brisbane and the Brisbane port is closed, preventing deliveries to some domestic and international customers. Rio Tinto Alcan is investigating alternative arrangements for customers, including shipping aluminium directly out of the Gladstone port. Rio Tinto Alcan is currently unable to provide an estimate of the full impact of the disruption to the supply of aluminium from Boyne Smelters Limited or the duration of the force majeure declaration.

Germany

ThyssenKrupp Stops Business with Iran

ThyssenKrupp AG has resolved with immediate effect not to enter into any new contracts with Iranian customers. ThyssenKrupp had previously instructed all Group companies, including engineering contractors such as Uhde, to comply with the stricter US sanctions against Iran (Iran Sanctions Act).

The latest Executive Board decision prohibits all new business with Iran and thus goes beyond the current sanctions measures, which relate primarily to the petroleum sector (oil and gas). Existing Group interests in Iran are to be terminated as quickly as possible. The Executive Board decision is to be implemented in the Group immediately.

Oman

Jindal Steel to Commission Oman Plant

Jindal Steel and Power said it will start commercial production from the *Shadeed Iron & Steel* plant in Oman, which it acquired recently for USD 464 million. The plant will be commissioned during the January-March period of the current financial year. The under-construction plant was acquired as part of the domestic firm's plans to expand its operations overseas. Capacity utilisation of the plant would be ramped up to 80 % by 2012. Shadeed is a 1,5-Mt/a, gas-based, hot-briquetted iron plant in the Sohar Industrial Port area of the country. *Al Ghaith Holdings* of the UAE sold Shadeed to the Indian firm.

JSPL, the nation's second-biggest steel producer by market value, is undertaking expansion of its steel operations in India, which includes setting up new gas-based steel units. At present, JSPL has an annual steel production capacity of 3 Mt/a in Chattisgarh. The size of the plant is being doubled at an estimated investment of INR 10 000 crore. The company is also investing an estimating INR 44 000 crore on two upcoming plants in Orissa and Jharkhand. Shadeed Iron was the first overseas steel acquisition by a domestic firm since 2007, when *Tata Steel Ltd* bought UK-based *Corus* for USD 12,9 billion and spent USD 1,63 billion to buy *Algoma Steel Inc.* Jindal Steel is expanding in the Middle East to tap adjacent markets.

The Naveen Jindal-led firm had resumed work on its USD 2,1-billion project in Bolivia, another major international venture, in August. The company is building a 1,7-Mt/a steel plant, a 6-sponge-iron unit and 10-Mt/a iron-ore pellet plant in that country.

Germany

Steuler and KCH Combine their Skills

Steuler has incorporated *Keramchemie GmbH (KCH)* and its international subsidiaries in the Steuler Group in recent months.

The two corrosion protection brands Steuler Industrieller Korrosionsschutz and Ke-ramchemie (KCH) with a strong international presence were then merged in a second step by November 2010, the company *STEULER-KCH GmbH* having been created from this strategic bundling.

The technology divisions of STEULER and KCH complement each other superbly. They comprise surface protection systems, fireproof systems and plastics engineering as well as the area of swimming pool construction.

These are accompanied by the material business including production facilities, complete engineering and assembly capacities, all distribution channels as well as the domestic and foreign subsidiaries and holdings.

STEULER-KCH is able to choose the most technically sophisticated and economically viable solution from its broad spectrum of materials and technologies along with customers.

Russia / Denmark

FLSmidth to Supply New Cement Production Line

FLSmidth has received a contract worth approximately EUR 30 million from Russian Open Joint Stock Company *Sebryakov Cement* for the supply of equipment for their new cement production line. The plant is located in Mihkailovka city, approximately 180 km North of Volgograd.

The order is based on an ongoing collaboration between Sebryakov Cement and FLSmidth which goes back to 2005 when the contract for a new, and until now the biggest cement mill in Russia, was signed. The new production line will substitute the existing wet line, reducing energy consumption significantly and increasing production with 1 Mt/a of clinker.

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preview issue 2/2011 (extract)

Company Profiles/Interviews
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- ER 2001 SLX – very low exsudation AZS product for glass furnace superstructures (Saint-Gobain CREE/FR)
- MgO-doped reaction-sintered ZrO_2-Al_2O_3-SiO_2 refractory materials (Petronas University)

Economy & Markets
- Energy consumption in the German glass industry from 1920 to 2010 (HVG/DGG)
- The refractories industry in ALAFAR countries

Special Circulation at:
9th INFUB, European Conference on Industrial Furnaces and Boilers, Estoril/PT, 26.–29.04.2011
Internat. Refractories Conference, Prague/CZ; 10./11.05.2011
52nd Cement Industry Technical Conference, St. Louis/US, 22.-26.05.2011
85th DGG Annual Meeting, Saarbrücken/DE, 31.05.–01.06.2011

Advertising Deadline: **14.03.2011**
Publication Date: **13.04.2011**

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