

QUALITY SUSTAINS.



Sustainability, a matter of principle

The 12 principles of sustainable chemistry lay the foundations of LANXESS Inorganic Pigments business philosophy.

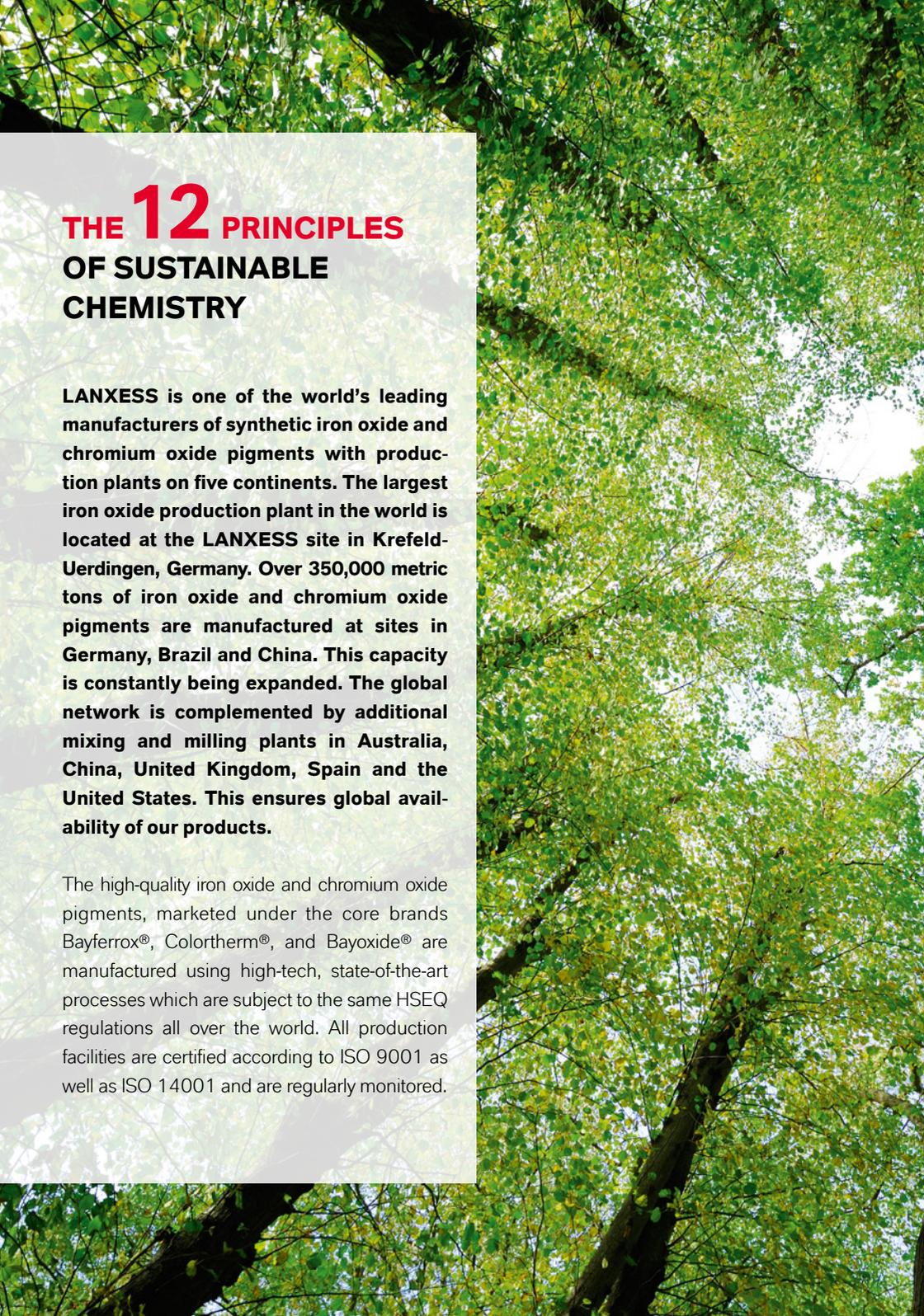
X BAYFERROX
Color for Life.

X COLORTHERM
Color for Life.

X Bayoxide

QUALITY WORKS.

LANXESS



THE 12 PRINCIPLES OF SUSTAINABLE CHEMISTRY

LANXESS is one of the world's leading manufacturers of synthetic iron oxide and chromium oxide pigments with production plants on five continents. The largest iron oxide production plant in the world is located at the LANXESS site in Krefeld-Uerdingen, Germany. Over 350,000 metric tons of iron oxide and chromium oxide pigments are manufactured at sites in Germany, Brazil and China. This capacity is constantly being expanded. The global network is complemented by additional mixing and milling plants in Australia, China, United Kingdom, Spain and the United States. This ensures global availability of our products.

The high-quality iron oxide and chromium oxide pigments, marketed under the core brands Bayferrox®, Colortherm®, and Bayoxide® are manufactured using high-tech, state-of-the-art processes which are subject to the same HSEQ regulations all over the world. All production facilities are certified according to ISO 9001 as well as ISO 14001 and are regularly monitored.



Sustainable practices and Responsible Care vis-à-vis the environment and society are an integral part of LANXESS' corporate guidelines. Production processes have always been designed to be safe and sustainable, to conserve resources and the environment. They are subject to continuous improvement.

Because of its commitment to operate all plants and processes according to the principles of sustainable chemistry, it is a matter of course that LANXESS complies with the 12 globally accepted principles of "green chemistry" published by P. Anastas and J. Warner in 1998.

We are fully convinced of the compliance of our actions and are sure we can offer our customers added value as a sustainable supplier. Based on the 12 principles of green chemistry, we would like to illustrate with the help of concrete examples how we operate on a day-to-day basis in accordance with our commitment to sustainability. That is precisely what makes LANXESS a very special partner in the pigments industry.

GREEN CHEMISTRY: THEORY AND PRACTICE by Anastas and Warner Fig.4.1 p.30
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>01

IT IS BETTER TO PREVENT WASTE THAN TO TREAT OR CLEAN UP WASTE AFTER IT HAS BEEN CAUSED.

The ecological and economic use of residual substances

At all its production sites, in Germany, Brazil and China alike, LANXESS uses efficient processes to clean and recycle process water.

For example at the plant in Krefeld-Uerdingen, Germany, an innovative process has been developed for cleaning process water containing residual iron. This uses a fluidized bed technology that is quite unique in the iron oxide pigments industry and enables the precipitated iron compounds to be turned into high-quality black

pigments. Thanks to this highly developed and sophisticated technology, several thousand metric tons of black pigments can be produced and the corresponding amount of waste can be avoided. Subsequently, the waste water is so clean that it can be discharged directly into the Rhine river.

The waste water concept of our Penniman red facility at our site in Ningbo, China includes state-of-the-art biological purification of the waste water to eliminate biodegradable ingredients.

>02

SYNTHETIC METHODS SHOULD BE DESIGNED TO MAXIMIZE THE INCORPORATION OF ALL MATERIALS USED IN THE PROCESS INTO THE FINAL PRODUCT.

Processes that benefit us and the environment

All LANXESS processes are designed in such a way that pigments are produced with a high yield.

With the help of efficient and proven synthesis engineering, a yield of nearly 100 % is achieved using the precipitation process for the production of Bayferrox® yellow pigments. Iron sulfate solution and sodium hydroxide solution are used in exactly the ratio required for the reaction. In addition, supply of the atmospheric oxygen needed for the synthesis has been technically optimized and the pH is accurately controlled during the reaction. In this process, virtually all of the iron raw material is converted into pigment, resulting in the best possible use of the resources.

Yellow pigments are also manufactured in very high yields at our other production facilities in Porto Feliz (Brazil) and Jinshan (China).



>03

WHEREVER PRACTICABLE, SYNTHETIC PROCESSES SHOULD BE DESIGNED TO USE AND GENERATE SUBSTANCES THAT POSSESS LITTLE OR NO TOXICITY TO HUMAN HEALTH AND THE ENVIRONMENT.



The commitment to quality and sustainability

The processes developed by LANXESS Inorganic Pigments – some of which have been established since 1926 – are environmentally friendly and are operated according to the strictest safety requirements. They are also subject to constant optimization.

The production processes used to manufacture these safe, environmentally harmless pigments ensure consistently high quality and conserve natural resources at the same time. They comply with the stringent environmental and safety requirements of the internal LANXESS directives and with all legal regulations.

These principles are strictly complied to not only at the main production site in Germany but, also at our synthesis plants in Brazil and China. All the production sites globally are certified to the strict quality and environmental standards ISO 9001 and ISO 14001.



>04

CHEMICAL PRODUCTS SHOULD BE DESIGNED TO EFFECT THEIR DESIRED FUNCTION WHILE MINIMIZING THEIR TOXICITY.

Protection of the environment and the benefits for mankind

LANXESS inorganic pigments are not hazardous. In chemical terms, synthetic iron oxide are comparable with naturally occurring iron oxides. With regard to their color, however, they are superior to their natural counterparts because of their higher purity and their particle morphology. In addition, synthetic iron oxides are, under normal conditions, stable and virtually insoluble

in water – an important requirement for safe handling and environmentally friendly processing.

Furthermore, LANXESS has developed a number of innovative iron oxides, for example, which are used in cathode materials in lithium-iron-phosphate batteries for electric vehicles, which help to enhance vehicle safety, or which are used to remove toxic elements from drinking water.



>05

THE USE OF AUXILIARY SUBSTANCES (E.G. SOLVENTS, SEPARATION AGENTS) SHOULD BE MADE UNNECESSARY WHEREVER POSSIBLE AND INNOCUOUS WHEN USED.

Natural solutions

With the processes employed by LANXESS for the production of iron oxide pigments, the only solvent used is water. This ensures maximum safety in the production, processing and isolation of the finished pigments.

The fact that only water is used is also of benefit to the environment, because without toxic organic solvents there is no need for any costly, energy-intensive recovery processes.

At all of our production sites, the water is reused in several stages of the process before being finally fed into a special waste water treatment unit, thus making optimal use of the water – the most valuable resource of all.



>06

ENERGY REQUIREMENTS SHOULD BE RECOGNIZED FOR THEIR ENVIRONMENTAL AND ECONOMIC IMPACTS AND SHOULD BE MINIMIZED. SYNTHETIC METHODS SHOULD BE CONDUCTED AT AMBIENT TEMPERATURE AND PRESSURE.

Saving and utilizing energy

Energy is an important resource, which LANXESS uses very conscientiously and responsibly at all its production sites.

An outstanding example of this is the Laux process in Krefeld-Uerdingen. It is currently the only industrially used process in the world for the production of iron oxides that does not require any energy at all during the synthesis, but itself releases energy in the form of heat. This heat is

used to generate steam or hot water to dissolve the iron sulfates or wash the pigments – a process that is currently unmatched in terms of its energy efficiency.

All the production plants at our sites use state-of-the-art technology for manufacturing iron oxide pigments. In China, for example, the use of special filter presses enables the subsequent drying time – and thus the energy consumption – to be reduced by more than 20 %.

>07

A RAW MATERIAL OR FEEDSTOCK SHOULD BE RENEWABLE RATHER THAN DEPLETING WHEREVER TECHNICALLY AND ECONOMICALLY PRACTICABLE.



The intelligent use of raw materials

The sustainable use of raw materials is a key priority for LANXESS.

Biomass is used as a source of energy for the production of iron oxide pigments at our site in Porto Feliz, Brazil. The on-site power plant, which was completed in 2010, runs for example on sugarcane waste (bagasse) or wood chips. The production of energy through a highly efficient combined heat and power generation technology (cogeneration) provides for a high level of utilization of this organic raw material. Energy generation for the site is thus completely CO₂-neutral. This means that the amount of CO₂ released during energy production corresponds to the amount of CO₂ absorbed by the plants during growth. Consequently, CO₂ output at the site is reduced to virtually zero. As from 2010, CO₂ emissions are around 44,000 metric tons lower compared to 2002 levels.



>08

UNNECESSARY DERIVATIZATION (USE OF BLOCKING GROUPS, PROTECTION/DEPROTECTION, TEMPORARY MODIFICATION OF PHYSICAL/CHEMICAL PROCESSES) SHOULD BE MINIMIZED OR AVOIDED WHENEVER POSSIBLE.

Superfluous things that can be avoided

The synthesis processes used by LANXESS at all its production sites are controlled in such a way that the iron oxides are already in a pure form in the desired crystal modification. Examples include goethite (yellow), hematite (red), magnetite (black) and lepidocrocite (orange). This eliminates the need for the complicated separation of modifications or a derivatization.

All this results from a wealth of experience and know-how gathered over a period of more than 85 years, from the use of state-of-the-art technology, from optimal process control by trained staff, and from a continuous drive for improvement.



>09

CATALYTIC REAGENTS (AS SELECTIVE AS POSSIBLE) ARE SUPERIOR TO STOICHIOMETRIC* REAGENTS.

The benefits of sound processes

The processes used by LANXESS for the production of iron oxides and chromium oxides result in high yields and involve relatively mild reaction conditions. The use of catalysts is generally of no significance here.

Catalytic processes are only used when it really makes sense – for example to remove pollutants from waste gases. Gaseous sulfur dioxide (SO_2), for instance, which is produced as an incidental by-product during the manufacturing of red iron oxides, is converted in a desulfurizing plant into sulfuric acid. Activated carbon serves as the catalyst. The sulfuric acid is concentrated using waste heat and then used as a raw material in the pigment process, sparing both the environment and valuable resources.

Regulatory requirements for the treatment of exhaust gases are met at all of our locations so that no pollutants are freely released into the environment. The design concept for our Penniman red facility at the site in Ningbo, China will also raise the bar for the cleaning of all exhaust gas emissions.

* The use of reaction partners in such quantities as determined according to the requirement calculated from the chemical reaction equation

>10

CHEMICAL PRODUCTS SHOULD BE DESIGNED SO THAT AT THE END OF THEIR FUNCTION THEY BREAK DOWN INTO INNOCUOUS DEGRADATION PRODUCTS AND DO NOT PERSIST IN THE ENVIRONMENT.

Products and their natural deposits

In terms of its percentage by weight, iron is the second most frequently occurring element on Earth, and at 5 %, is the fourth most common in the Earth's crust. In enriched form, it occurs very frequently as magnetite and hematite in giant ore deposits in various regions of the Earth.

Chemically, iron oxide pigments produced by LANXESS are comparable with these natural deposits and thus are equally safe for the environment.





>11

ANALYTICAL METHODOLOGIES NEED TO BE FURTHER DEVELOPED TO ALLOW FOR REAL-TIME, IN-PROCESS MONITORING AND CONTROL PRIOR TO THE FORMATION OF HAZARDOUS SUBSTANCES.

Controls and how we carry them out

All LANXESS production processes are controlled and monitored by the state-of-the-art analytical and physical methods. Continuous measurement of key process parameters enables individual steps in the synthesis process to be reliably controlled.

This also applies to the streams of waste air and waste water, which are monitored using state-of-the-art analytical techniques. Potential malfunctions are recognized so that the uncontrolled release of substances can be prevented. LANXESS also relies on state-of-the-art technologies for quality control.



>12

SUBSTANCES AND THE FORM OF A SUBSTANCE USED IN A CHEMICAL PROCESS SHOULD BE CHOSEN TO MINIMIZE THE POTENTIAL FOR CHEMICAL ACCIDENTS, INCLUDING RELEASES, EXPLOSIONS, AND FIRES.

Safety, and how it is ensured

All LANXESS Inorganic Pigments production processes globally are subject to the same high safety standards. All production plants are designed in such a way that the uncontrolled release of substances cannot occur; continuous monitoring provides for additional safety. Fire and explosion protec-

tion measures are an integral part of project engineering and modernization concepts.

The effectiveness of the safety measures is assured and documented by regular safety checks. In this respect there are no differences between the sites because LANXESS follows these principles all over the world.

We do not make any compromises on either economics or ecology.

We are convinced that companies will only be able to operate successfully in the future if they act sustainably towards the environment and society.

This is and will remain an indispensable element of our business philosophy.

LANXESS
Energizing Chemistry

LANXESS Deutschland GmbH
Business Unit Inorganic Pigments
47812 Krefeld
Germany
Tel.: +49 221 8885 5641
www.lanxess.com
www.bayferrox.com

LANXESS Corporation
Business Unit Inorganic Pigments
111 RIDC Park West Drive
Pittsburgh, PA 15275 -1112
USA
Tel. +1 412 809 1000
www.lanxess.us
www.bayferrox.us

Health and safety information

Appropriate documentation was compiled with information on the health and safety measures that have to be observed in handling the LANXESS products mentioned in this brochure. For materials mentioned here that are not LANXESS products, the operational hygiene and other safety measures recommended by the respective manufacturers must be observed. Before working with these products, you must read and familiarise yourself with the available information on their dangers, proper use and handling. This point is of decisive importance.

Information is available in various forms: such as safety data sheets, product information and product labels. Please contact your LANXESS representative in Germany or the Department of Regulatory Affairs and Product Safety of LANXESS Deutschland. For business in the USA, please contact the LANXESS Product Safety and Regulatory Affairs Department in Pittsburgh, Pennsylvania.

Information on Regulatory Compliance

For some end use purposes of the products found in this brochure, the applicable regulations must be observed, including those of the FDA, BfR, NSF, USDA and CPSC. If you have any questions regarding the approval status of these products, please contact your representative at LANXESS Deutschland GmbH or the Department of Regulatory Affairs and Product Safety of LANXESS Deutschland GmbH or, for business in the USA, your representative at LANXESS Corporation, the LANXESS Regulatory Affairs Manager in Pittsburgh, Pennsylvania.

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