

ELCOvit

Micronutrients for the World

Leader in flour applications.



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Organic Control Number: DE-ÖKO-001


Mühlenchemie

– a strong partner in fighting nutrient deficiency.

A permanent undersupply of nutrients threatens the lives of millions of people throughout the world. A lack of vital vitamins and minerals results in symptoms such as impaired performance, retarded growth, damage to the nervous system and an increased risk of infection. So the fortification of flour with micronutrients makes an important contribution to winning the fight against global nutrient deficiency.

For 90 years Mühlenchemie has helped mills around the globe with carefully adjusted additives for enhancing the processing characteristics of flour and with individual premixes tailored to the nutrient requirements of different countries. As a leading international supplier of flour improvers we now export Mühlenchemie products to over 100 countries. And the number is growing, because there is a great demand for vitamin and mineral mixtures and flour fortification is, in fact, prescribed by law in many countries. We now offer over 250 highly specific premixes, designed to meet the needs of the market and our customers' wishes.

The centre of our applications research is in Ahrensburg, near Hamburg, where innovative product solutions are devised in 14 specialist laboratories on a area of 3,000 m². The highly specific compounds of active ingredients are made up on our precision blending plant in Wittenburg. So each of our customers can be sure of getting a micronutrient mixture accurate to the gram and carefully adjusted to the particular needs. For our customers this is a promise of quality; for global health promotion it is a major step that saves the lives of millions of people around the world and at the same time helps to cut costs in the health sector.

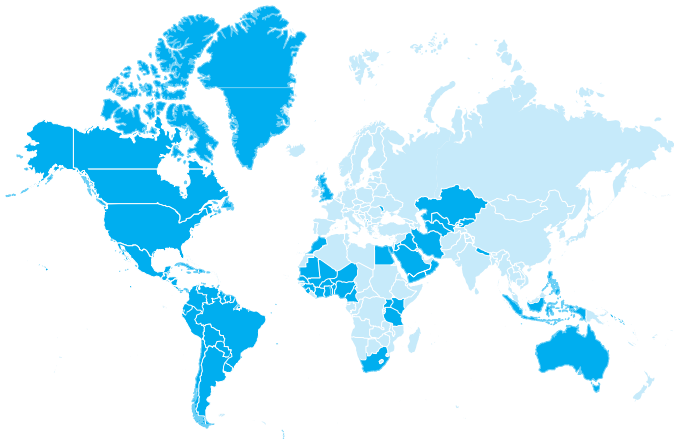
A close-up photograph of a young child's face, looking down and slightly to the right. The child has dark skin and large, dark eyes. They are wearing a vibrant, patterned garment with blue, red, and white colors. The background is a soft, out-of-focus yellow. A dark blue horizontal band is overlaid across the middle of the image, containing white text.

**The worldwide hunger for
adequate nutrition is great
– and so is our determination
to satisfy it.**

Global flour fortification – a success story

Worldwide consumption of industrially produced flour is high. Flour containing vitamins and minerals makes a significant contribution to preventing nutrient deficiencies. Governments, international foundations, non-governmental organizations and companies like Mühlenchemie therefore support the cause of global flour fortification with additional nutrients – and their efforts are meeting with success. In 76 countries, flour fortification is prescribed by law. 3 countries follow the WHO recommendations voluntarily and take part in the flour fortification programmes; a further 22 are in the planning phase.

Legislation on fortification of wheat flour



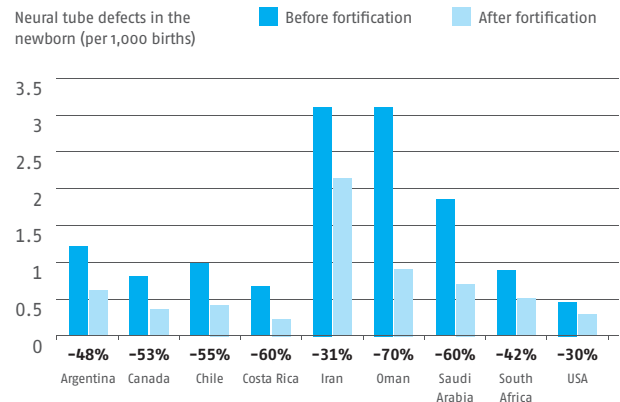
Stage reached in flour fortification, June 2013. 76 countries promote the fortification of flour with at least iron and/or folic acid.

Source: FFI, 2013

More nutrients at little cost

Compared with the enormous benefit compensating for nutritional deficiencies brings in terms of health and the national economy, the fortification of flour costs little. According to EMORY, Rollins School of Public Health, expenditure on flour fortification amounts to 50 US cents per person and year. The cost can even be reduced to 10 US cents, depending on the type of fortification and the required amounts. Since modern mills are usually well equipped for flour fortification, the only additional costs occurring in the fortification process are for the purchase of the premixes, and these amount to just a few US dollars per ton of flour.

Success of fortification



Source: FFI, 2013

Flour fortification: a benefit to the economy

Chile and the USA offer two important examples of the saving in costs that can be achieved with flour fortification. In Chile, every US dollar spent on the fortification of flour with folic acid saved 11.8 US dollars in medical costs. The example of the USA is even more impressive: the cost of treatment and care for children with spina bifida fell by 145 million US dollars a year through the addition of folic acid.

Sustainability: cooperation with FFI, GAIN and WHO

More and more countries are making efforts to eliminate global malnutrition. 22 states have already incorporated the right to nutrition in their national legislation or their constitution. With the programme "Millennium Development Goals" (MDGs) of September 2012, 187 states undertake "to halve the proportion of the world's population with an income of less than 1 dollar per day and the proportion of the population suffering from hunger by the year 2015". An important role in the campaign against malnutrition is played by the Flour Fortification Initiative (FFI), an international network of universities, public institutions and private enterprise. With the aim of eradicating worldwide malnutrition, Mühlenchemie cooperates closely with the FFI, the Global Alliance for Improved Nutrition (GAIN) and the WHO. Inspired by the objective of finding a country-specific answer to vitamin and mineral deficiency, Mühlenchemie has developed the special micronutrient compounds of the ELCOvit product family.



The addition of micronutrients costs little; doing without them costs lives.

Vitally important: vitamins and minerals

Vitamins, minerals and trace elements serve to maintain important bodily functions and are involved as biocatalysts in nearly all metabolic processes in the organism. Vitamins ensure the breakdown and conversion of carbohydrates, protein, fat and minerals. The latter control the transmission of nerve signals and the work of the muscles. Important as vitamins, minerals and trace elements are: the body cannot itself synthesize and store them in sufficient amounts. Humans are therefore dependent on a daily supply of these essential micronutrients through their food.

Flour: an important carrier of nutrients

Pasta and bakery products are staple foods in nearly all countries. 600 million tons of wheat and maize flour are produced every year and consumed as noodles, bread or other flour products. The worldwide use of flour as a staple food shows that it is an excellent means of supplying large sections of the population with vitamins and minerals – provided that its nutrient content meets the specific needs of the region.

Loss of nutrients in the production of flour

For the production of fine, white flour the cereal grains are shelled, and parts that are difficult to process are removed. But in this process important nutrients are lost. Light-coloured flour therefore contains only one-tenth to one-third of the original amount of vitamins and minerals. Subsequent fortification of the flour with premixes is a simple and also inexpensive way of maintaining the good processing properties of light-coloured flour and compensating for the loss of nutrients.

Flour fortification: an individual solution

Fortification of flour with vitamins and minerals promotes health and contributes to a higher life expectancy worldwide. But flour fortification is not the same for everyone. The composition of the mixtures added must be adjusted precisely to the needs of the particular country. So it is important first to establish the nature of the nutrient deficiency, its severity, the consumption of bakery products or pasta per head of the population and the level of extraction of the flour to which the premix is to be added.

Vitamin and mineral content of wheat and some products ground from wheat

Constituent	Unit <small>ppm = parts per million</small>	Wholemeal	Bran	Wheat germ	Flour, Type 550
Minerals	%	1.67	6.15	4.2	0.47
Iron	ppm	32	160	8.5	10
Folic acid	ppm	0.87	1.95	5.2	0.16
Carotenoids	ppm	0.2	0.055	0.62	Traces
Vitamin B1	ppm	4.62	6.5	20	1.1
Vitamin B2	ppm	0.94	5.1	7.2	0.45
Vitamin B6	ppm	2.69	7.29	4.92	1



Vitamin A: too little causes blindness

The WHO estimates that some 127 million children worldwide suffer from a vitamin A deficiency at pre-school age. In 13.8 million children, a vitamin A deficiency results in impaired vision. Each year, as many as 500,000 children go blind. About half of these children die within a year of going blind. Vitamin A deficiency is most common in Africa and South East Asia. Besides children, pregnant women are the group with the greatest risk. Every year, about 600,000 women with a vitamin A deficiency die in childbirth.

About vitamin A

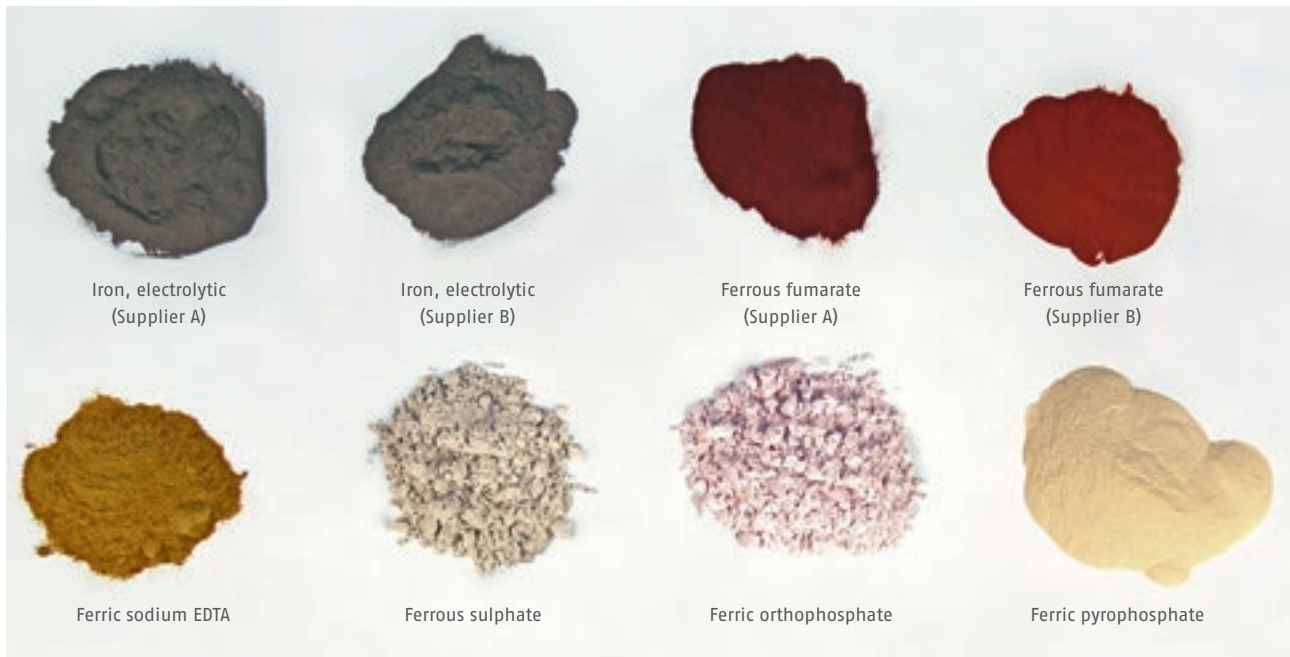
Vitamin A is taken in through the food or formed from one of its precursors provitamin A or carotene. It promotes the synthesis of protein, influences cell growth and strengthens the structure and functioning of the skin and mucous membranes. It also stimulates the formation of white blood cells and antibodies. As an important constituent of visual purple, vitamin A is instrumental in the conversion of light into nerve impulses. A vitamin A deficiency (hypovitaminosis) results in increased susceptibility to infection, night blindness, impaired visual acuity, reduced fertility, fatigue, and poor bone growth in childhood.

Folic acid: essential for prenatal development

Of 130 million babies born each year, 200,000 have deformities. It is assumed that 70 percent of the deformities could be prevented by the administration of 0.4 mg of folic acid per day. The USA and Canada offer an example that this assumption is correct. In both countries the addition of folic acid to flour is prescribed by law. Since this legislation, only about half as many children have been born with neural tube defects such as spina bifida, anencephaly or a cleft of the lip, upper jaw, and palate.

About folic acid

Folic acid is an essential B vitamin. Together with enzymes it is involved in the synthesis of certain amino acids (methionine, glycine, serine, cysteine) which are relevant for the structure of DNA and RNA. Folic acid therefore promotes the maturation, differentiation and division of cells, especially red and white blood cells and the cells of the mucous membranes. Embryos, especially, react very sensitively to a folic acid deficiency because of their rapid cell division rate. An inadequate supply of folic acid therefore often results in damage to the central nervous system and deformities such as spina bifida in the newborn. The recommended daily allowance of folic acid for a human being is 200 µg, for pregnant women about 400 µg.



Different types of iron compounds

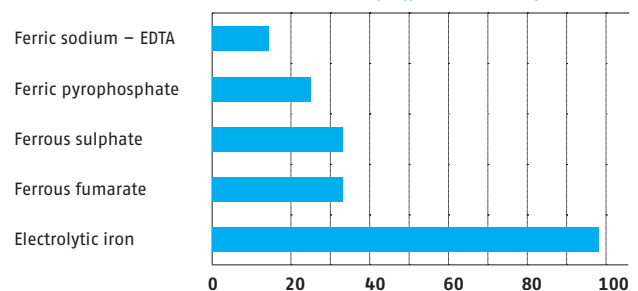
Fortification of flour with iron

For the addition of iron, especially, the level of extraction of the flour plays an important role: different types of iron are to be recommended, depending on the fineness of the flour. A distinction must be made between ferrous fumarate, ferric –III–sodium–EDTA, electrolytic iron and ferrous sulphate. Recent investigations have revealed that ferric –III–sodium–EDTA is the most effective of these as a food additive. It is especially suitable for fortifying dark, high-extraction flour. Other compounds recommended for flour fortification are ferrous fumarate, ferrous sulphate and electrolytic iron in double concentration.

Iron deficiency: the main cause of anaemia

Anaemia is the most common disorder associated with nutrition. The WHO estimates the number of persons affected at about two billion. In the developing countries, one pregnant woman in two and 40 percent of the children of pre-school age suffer from the disease. The main cause of anaemia is insufficient iron in the daily diet. If too little iron is taken in, the risk of infection increases; the productivity of the adult population falls and maternal mortality rises. Iron deficiency also affects prenatal development: the newborn babies are smaller, and they may show impaired mental development and retarded growth. Fortifying flour with iron cannot always prevent these disorders, but it makes an important contribution to reducing them.

Iron content (in %) of different iron compounds



About iron

Iron is one of the most important trace elements in the human body. It is contained in the oxygen transport protein haemoglobin and the muscle protein myoglobin. Oxygen transport, oxygen uptake, important cell functions such as mitochondrial electron transport and the entire metabolic system are dependent on an adequate supply of iron. The daily iron requirement is between 8 and 14 mg in adults and up to 27 mg for women during pregnancy. If too little iron is taken in with the food, the oxygen supply to the cells is inadequate. This results in anaemia, lowered resistance to disease, severe fatigue and poor concentration.



Regional nutrient deficits can be compensated for – with the right premix.

ELCOvit: the solution for high-nutrient flour

ELCOvit premixes are individual mixtures of nutrients carefully designed to meet the nutritional requirements of the country concerned. The combinations of micronutrients take regional deficits and eating habits and also the availability of foods into account. These extremely specific products are manufactured at one of Europe's most modern blending plants. ELCOvit premixes are filled solely into bags made of aluminium composite foil, impermeable to oxygen, and packed in strong fibreboard boxes. This ensures optimum protection of the vitamins, even during long transportation and storage.

Advantages of the ELCOvit premixes:

- Standard premixes for flour in accordance with legal requirements; can also be adjusted individually
- Premixes for bakery products, noodles, biscuits, cereals etc., taking processing losses into account
- Many years of experience in the development and production of premixes

- Aluminium packs
- Use of highly stable raw material qualities, for example vitamin A from BASF
- Ready premixes make individual weighing of the microsubstances unnecessary
- Easy integration into the production process

Mühlenchemie premixes: a combination of experience and the latest findings

For ten years Mühlenchemie has supplied the market with innovative ELCOvit premixes. International co-operation with prestigious organizations like FFI, GAIN, WFP, U.S. Wheat Associates and World Health Organization ensures that we develop our product range continuously in accordance with international requirements. To enable our customers to use our ELCOvit products as efficiently as possible we also offer workshops, symposiums and technical support.

Africa

Product	Region
ELCOvit 10646	Cameroon
ELCOvit 12266	
ELCOvit 2475	Congo
ELCOvit 2475 EF	
ELCOvit 2639	Egypt
ELCOvit 2159 GH	Ghana
ELCOvit 2639	Iraq
ELCOvit 11349	Ivory Coast
ELCOvit 12110	Kenya
ELCOvit 12109	
ELCOvit 12045	Mali
ELCOvit 12046	
ELCOvit 2027	Morocco
ELCOvit 2227	
ELCOvit 12279	Mozambique
ELCOvit 2017 N1	Nigeria
ELCOvit 13322	
ELCOvit 12350	South Africa
ELCOvit 12351	
ELCOvit 2310	Sudan
ELCOvit 11460	Tanzania
ELCOvit 11463	
ELCOvit 12119	Togo
ELCOvit 2654	Uganda
ELCOvit 2655	
ELCOvit 2699	Zambia

Asia

Product	Region
ELCOvit BD 2	Bangladesh
ELCOvit 2062	China
ELCOvit IN-WB-01	India
ELCOvit IN-WB-02	
ELCOvit IN-TN 01	
ELCOvit IN-RJ 01	
ELCOvit IN-GJ 01	
ELCOvit 2033	Indonesia
ELCOvit 2033 EF	
ELCOvit 2033 ES	
ELCOvit 10500	
ELCOvit SNI	
ELCOvit 11310	Malaysia
ELCOvit PK	Pakistan

Asia

Product	Region
ELCOvit 28414	Philippines
ELCOvit 28414 EF	
ELCOvit 2414	
ELCOvit 10524	
ELCOvit 2484	Taiwan
ELCOvit 2270	Vietnam

Central Asia

Product	Region
ELCOvit 28190	Azerbaijan, Kazakhstan, Kyrgyzstan, Mongolia, Tadzhikistan
ELCOvit 2281	Uzbekistan

Australia

Product	Region
ELCOvit 29252	Australia
ELCOvit 29257	

North/South America

Product	Region
ELCOvit 2035 RCH	Argentina, Chile
ELCOvit Bol-10	Bolivia
ELCOvit 2072	Brazil
ELCOvit 4034 EF	Costa Rica
ELCOvit 10216	Ecuador
ELCOvit 29408	Canada
ELCOvit 210096	
ELCOvit 3014	Colombia
ELCOvit 4100	Mexico
ELCOvit 2080	Paraguay
ELCOvit 2058	Peru
ELCOvit 2268 ES	Uruguay
ELCOvit 2268 EF	
ELCOvit 2039 TT	USA
ELCOvit 28507	
ELCOvit 2015	Venezuela
ELCOvit 2034 EF	Central America

UK

Product	Region
ELCOvit 29508	UK

Effective premixes require a market know-how, special expertise – and a stable base.

Vitamin A: essential and extremely sensitive

Vitamin A plays a major role in the maintenance of health, but unfortunately it is extremely sensitive to UV light, oxygen, heat and moisture. Since the main regions in which fortified flour is used often have a tropical climate, vitamin A can lose its efficacy very quickly. Mühlenchemie's aim was therefore to develop, together with its partner BASF, a vitamin A powder that would be resistant to damaging environmental influences and withstand long storage periods.

ELCOvit A 250: a stable product for high-nutrient flour

The result is ELCOvit A 250, a stable vitamin A palmitate powder. An activity test developed by the USDA (United States Department of Agriculture) showed that ELCOvit A 250 still had over 90 percent stability even after 21 days of storage at 45°C. Samples from competitors were shown to have between 10 and 70 percent stability – in other

words, they were below the stability index of 80 percent necessary for processing. A further test simulated the conditions at a mill during the rainy season. The result: whereas similar products formed lumps and lost their efficacy, ELCOvit A 250 remained active and free-flowing.



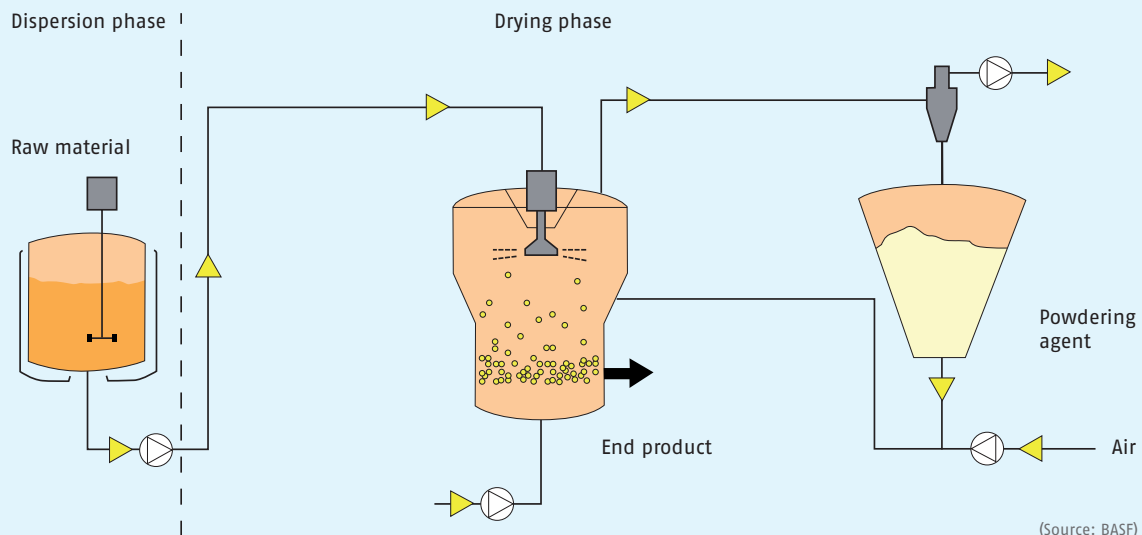
Comparison of the tendency of vitamin A powder to form lumps after 1 hour of storage at 80 % relative humidity and 35°C (right side ELCOvit A 250, left side the product used for comparison).

Microencapsulation: the key to success

The excellent stability of ELCOvit A 250 is made possible by BASF's beadlet technology, a very gentle drying process for the product combined with a highly effective antioxidant system. Thanks to a strategic partnership with BASF, Mühlenchemie succeeded in modifying the beadlet process and adjusting it for the purpose of flour fortification. In this way it was possible, in a short time, to produce a vitamin A powder that runs through a 250 µm screen – normally an impossible size for beadlet technology.



About BASF beadlet technology



(Source: BASF)

The oily vitamin A concentrate is dispersed very finely in an encapsulation matrix and water, then emulsified and sprayed at low temperatures in a drying chamber. The water evaporates immediately, leaving the vitamin powder. The BASF beadlet method offers the following advantages over the classic method:

- The compact beadlet particles contain less entrapped air. They therefore break open less easily, which means that the vitamin A has greater protection against oxygen.
- The beadlets have a particle size between 150 and 250 µm. They therefore offer a smaller surface area for attack by oxygen than powder made by the classic method, with grain sizes around 100 µm.
- The vitamin A is further protected against oxidation and moisture by an extra coating of starch that encapsulates each particle. In this way ELCOvit A 250 remains stable and free-flowing even in a tropical climate.
- In order to increase its stability still further, the product is given special protection against oxidation.

**Customers' wishes
and accurate dosing:
both are things
we take very seriously.**



Gentle filling of the ELCovit premixes
in special fibreboard boxes with an
inner aluminium bag



The basis for quality products: our precise blending technology

Compounds of active ingredients in powder form and micronutrient premixes are mixed systems consisting of substances whose effects complement each other; they are bound to inert carriers. Essential requirements in the production process are accurate weighing, uniform particle size, and homogeneous distribution of the components of the mixture. Since vitamins and minerals are sensitive substances it is important to protect the constituents against light, oxygen, moisture and high temperatures throughout the process.



Designed to pharmaceutical standards: our compounding plant

In order to offer its customers first-class premixes conforming to pharmaceutical standards, Mühlenchemie built one of Germany's most modern precision blending plants for vitamin premixes, mineral mixtures and flour improvers in Wittenburg in 1999. All micronutrients are compounded there with great care, and accurately to the gram. Since international demand for quality premixes and compounds of active substances is increasing all the time, Mühlenchemie has since enlarged its production plant continuously and widened its range of products – still maintaining its uniformly high quality.

Special features of our precision blending plant:

- Three centrally controlled, separate and independent production lines specially designed for adding the microsubstances and distributing them homogeneously
- Fully automated feeding of the blenders, with dosing accurate to the gram, documentation of each separate batch and numbering of the containers
- Modern process technology permitting extremely close adherence to formulations and maximum safety and reliability
- Gentle processing of the products

Flour fortification is a matter of experience – and the right equipment.

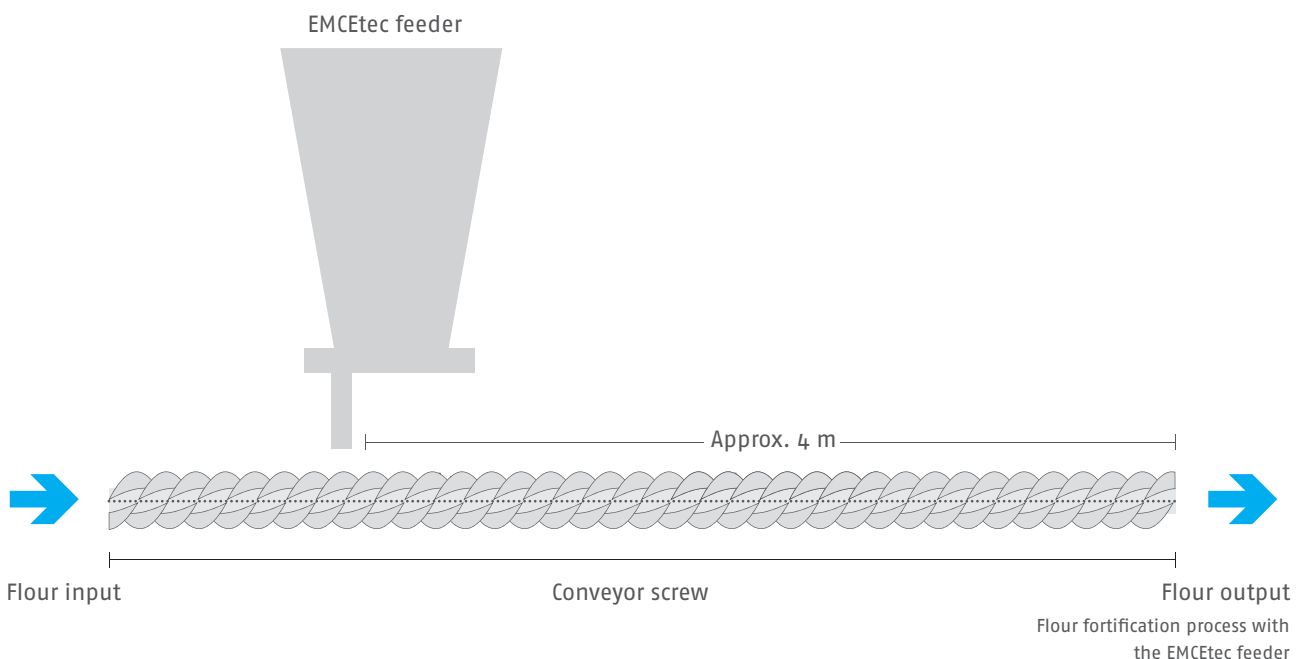
Flour fortification is a process that requires extreme care. We help our international clientele to proportion all the ingredients accurately – with our knowledge, and with modern equipment.

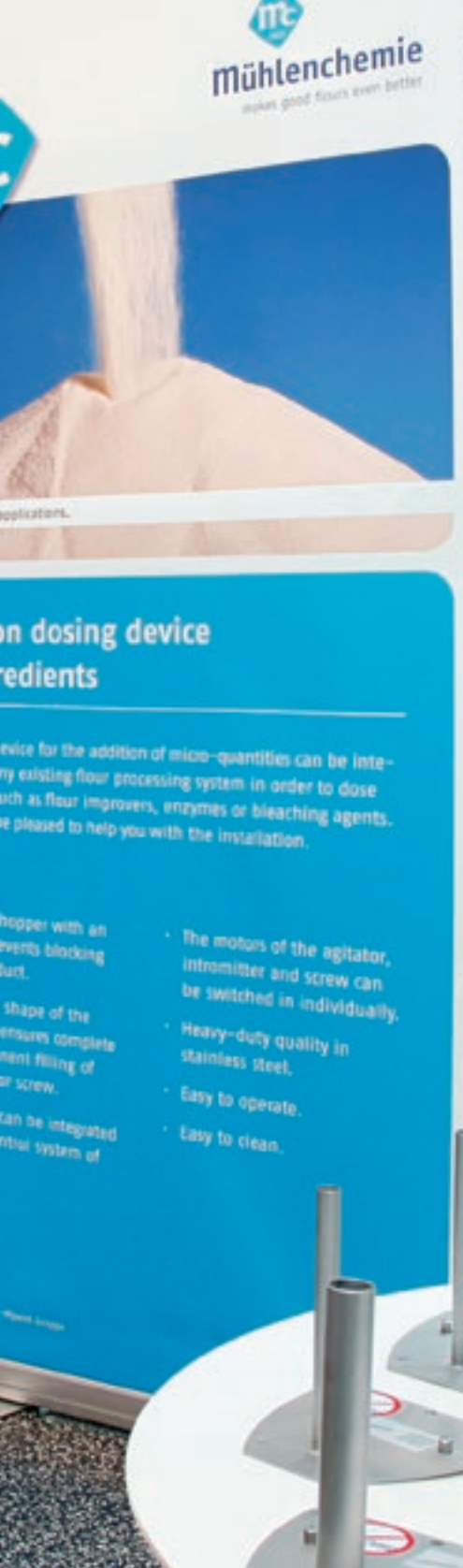
For dosing accurate to the gram at your facility: the feeder

Mühenchemie's EMCETec feeder makes it possible to produce formulations accurate to the gram and achieve extremely fine distribution of the micronutrients. The feeder can be integrated into any production and control system and has proved its worth in many countries. We can help our customers install and use the equipment correctly – with our reliable on-site service.

Advantages of the EMCETec feeder:

- Robust, stainless steel quality
- Circular funnel with an agitator to prevent the product from sticking to the sides
- Specially shaped second agitator for complete and permanent refilling of the screw
- Motors of the agitators and screw can be switched on separately
- Easy to operate and clean





The feeder as an exhibit at the 4th Mühlencemie Symposium

Everything under control: with the Mühlencemie tests

Flour fortification needs constant quality control. In order to test the concentration and homogeneous distribution of the additives, Mühlencemie offers a number of test kits for the quantitative and qualitative analysis of flour.

- Inexpensive and semi-quantitative tests
 - Iron spot test
 - Vitamin A test kit for flour
- Quantitative analyses using BioAnalyt test kits
 - Iron test kit (iCheck IRON)
 - Vitamin A test kit (iCheck FLUORO)
- Quantitative tests at the Mühlencemie laboratory or by the internationally recognized SGS Institute



It's objectivity that counts

We offer our customers individual solutions – on an optimum quality level. In order to ensure that Mühlenchemie meets all QA criteria, regular audits are carried out in our company by independent, accredited institutions. Everything is subjected to a close examination, from the production process itself to a review of the entire system. Our quality management includes precise information on the origin of the raw materials used.

Quality assurance in the production process

- Automatic standard control sifting from 0.5 to 5 mm, depending on product attributes
- Metal detection
- Easy-to-clean plant design for maximum quality and flexibility
- Unbroken chain of documentation
- Reliable traceability of batches of raw materials and packaging
- Regular conduct of employee training
- HACCP system
- Allergen management
- GMP-certified production conditions
- FSSC 22000 (Food Safety System Certification)
- "Bio" seal for organic products
- Kosher and halal management
- Organic control number: DE-ÖKO-001





We supply top quality – and for that we give you our word.

Our production plant in Wittenburg

Information on the topic

Organizations

www.ffinetwork.org
Flour Fortification Initiative

www.adb.org
Asian Development Bank

www.unicef.org
United Nations Children's Fund

www.who.int
World Health Organization

www.paho.org
Pan American Health Organization

www.sustaintech.org
Sharing Science and Technology to improve Nutrition in developing Countries

www.gainhealth.org
Global Alliance for Improved Nutrition

www.micronutrient.org
The Micronutrient Initiative

www.iom.edu
Institute of Medicine

http://fnic.nal.usda.gov
U.S. Food and Drug Administration

www.nal.usda.gov
Food and Nutrition Information Center

www.wfp.org
World Food Programme

www.hki.org
Helen Keller International

www.izincg.org
International Zinc Nutrition Consultative Group

www.ifglobal.org
International Federation for Spina Bifida and Hydrocephalus

www.idpas.org
Iron Deficiency Project Advisory Service

www.cdc.gov
Centers for Disease Control and Prevention

www.usaid.gov
United States Agency for International Development

www.a2zproject.org
The USAID Micronutrient and Child Blindness Project

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