

A close-up photograph of a woman with long, light brown hair, her head tilted back and eyes closed. She is smiling slightly as a fine mist of white powder is sprayed into her open mouth from a silver, cylindrical device held by a hand on the right. The background is a soft, out-of-focus grey.

# Micro- encapsulated Mineral Salts



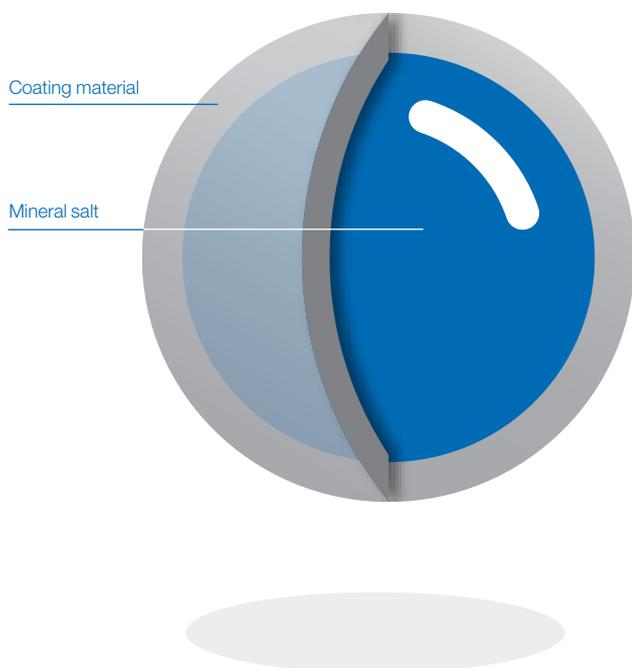
**Dr. Paul Lohmann<sup>®</sup>**

**High value mineral salts**

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## Microencapsulation – Innovative Solutions and new Fields of Application



Food and food ingredients are very sensitive products. They have to be protected against several physical influences like heat, moisture or light as well as against undesired interactions of ingredients. Microencapsulation helps to avoid negative effects by protecting the core material from the surrounding environment.



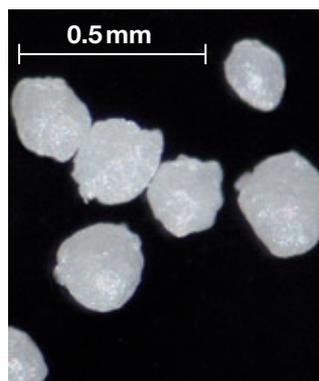
- ◆ Excellent taste masking properties
- ◆ Prevention of interaction with other ingredients
- ◆ Improved storage stability

## Advantages of micro-encapsulated Products

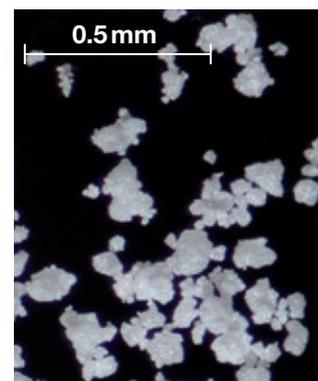
- ◆ Prevention of interactions with other ingredients, e.g. fat oxidation, vitamin degeneration and discoloration<sup>1,2</sup>
- ◆ Excellent taste masking properties<sup>3</sup>
- ◆ Gastric resistance, no metallic tasting eructation
- ◆ No irritation of the digestive system
- ◆ Improved stability of final product during processing, transport and storage<sup>1</sup>
- ◆ Improved flowability and dosing, less dust formation
- ◆ Similar bioavailability compared to non-encapsulated minerals<sup>4</sup>

### Micro2: micronized and microencapsulated Mineral Salts – additional advantages

- ◆ Smaller particle size (d90: approx. 300 µm)
- ◆ Enlarged specific surface
- ◆ Improved functionality



Ferrous Sulfate microencapsulated



Ferrous Sulfate Micro2 micronized & microencapsulated

During the physical coating process, a core-shell particle is formed by covering the mineral salt with a layer of sustainable produced palm oil. Beside the palm oil and non-hydrogenated palm oil, rapeseed- and sunflower oil are available as coating material. On request, it is possible to work on further mineral salts and coating material combinations. Due to this encapsulation technology, every particle of the Mineral Salt is enclosed in microcapsules, while maintaining their natural function. Furthermore, the coating material offers excellent taste masking properties.

## Application Areas

- ◆ Dietary supplements
- ◆ Powdered dairy products
- ◆ Instant beverages
- ◆ Bakery goods
- ◆ Confectionary

## Matrix Encapsulation

Another kind of encapsulation is the matrix encapsulation. In contrast to the core-shell particle which results from a coating process, the active ingredient is spread homogeneously in the entire particle. The encapsulation is carried out by a spray drying process, which is often used for the encapsulation of sensitive food ingredients.<sup>5,6</sup> During this process an active ingredient is entrapped by a protective wall material due to a rapid evaporation of the solvent (often water).

A well known wall material for spray dried microcapsules is maltodextrin. It has film-forming properties and can therefore reduce the oxygen permeability of the wall matrix and sensitive ingredients are protected during storage.<sup>7,8</sup>

# Microencapsulation with vegetable Fat Coatings

The hydrophobic fat coating of the microencapsulated particles prevents the release of the Mineral Salt in aqueous solutions. Temperature controlled release experiments show a release from the palm oil encapsulated product between 50 and 60 °C, whereas the release from sunflower and rapeseed oil encapsulated products starts at 60 °C (Fig. 1).

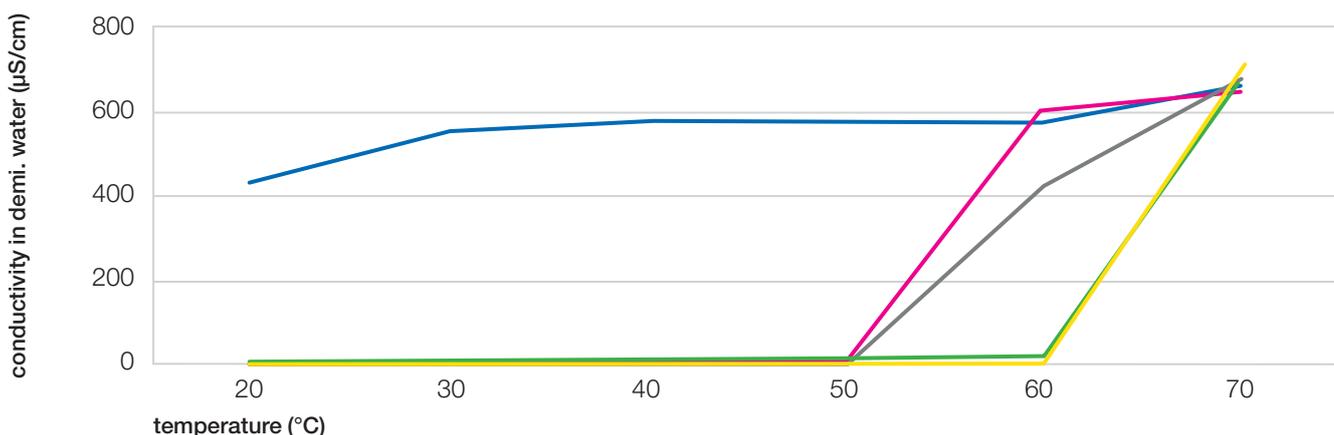
Drug release experiments in simulated gastric juice show a very similar releasing behavior of the different coating materials. The non-encapsulated product is completely dissolved after 20 minutes. The release rate from the encapsulated products is below 10 % after 100 minutes (Fig. 3a). The release from palm oil and sunflower oil coated particles is below 5 %, thus a tight enteric coating is achieved (Fig. 3b).

Furthermore, the release of all encapsulated products in simulated intestinal fluid is between 75-90 % after 180 minutes. The release of non-hydrogenated palm oil and sunflower oil is faster in comparison to hydrogenated palm oil and rapeseed oil (Fig. 2).

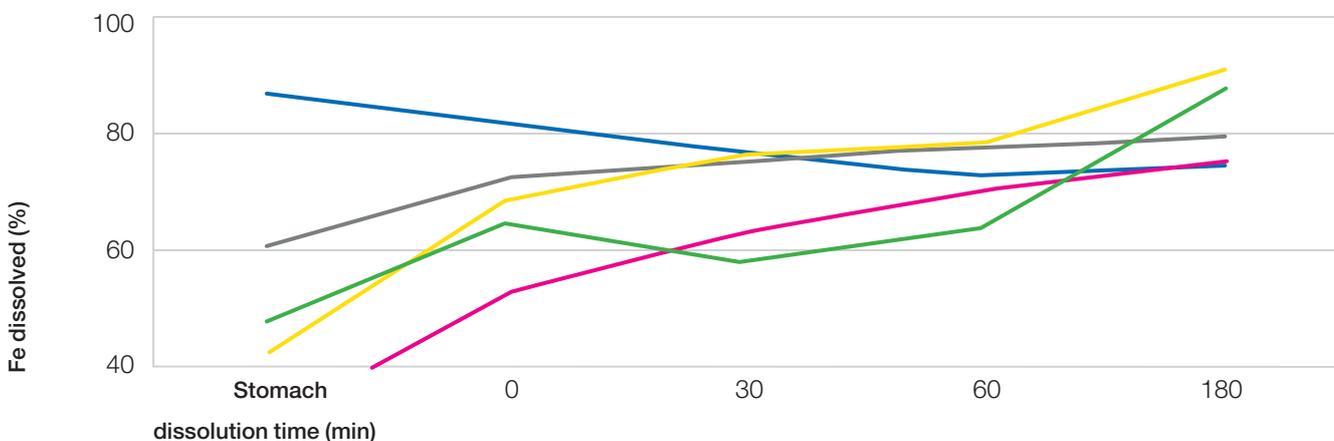
Depending on the final application, the most suitable product can be chosen.

The microcapsules have a high level of homogeneity, proven by a narrow particle size distribution. Our microencapsulated Mineral Salts are resistant against mechanical stress resulting from feeder equipment, bulk containers or conventional dry mixing plants.

**Temperature controlled release of Ferrous Sulfate after 30 minutes in water (Fig. 1)**



**Release of Ferrous Sulfate with different capsule materials in simulated intestinal solution, 37 ± 0.5°C (Fig. 2)**



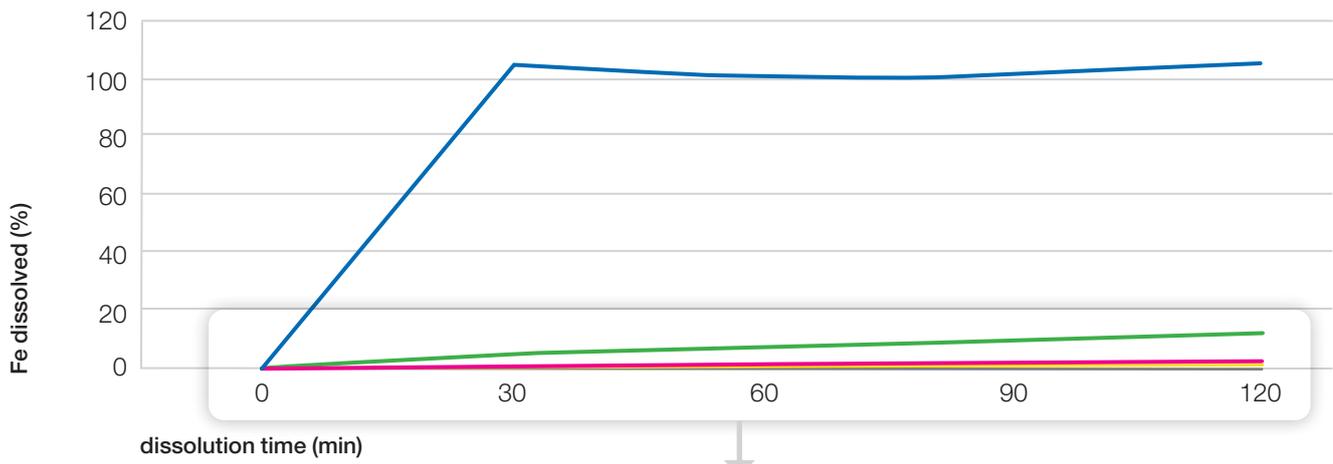
- Ferrous Sulfate without capsule
- Ferrous Sulfate encapsulated with non-hydrogenated palm oil (Product no. 522005995)
- Ferrous Sulfate encapsulated with hydrogenated palm oil (Product no. 522005910)
- Ferrous Sulfate encapsulated with hydrogenated rapeseed oil (Product no. 522005974)
- Ferrous Sulfate encapsulated with hydrogenated sunflower oil (Product no. 522005975)



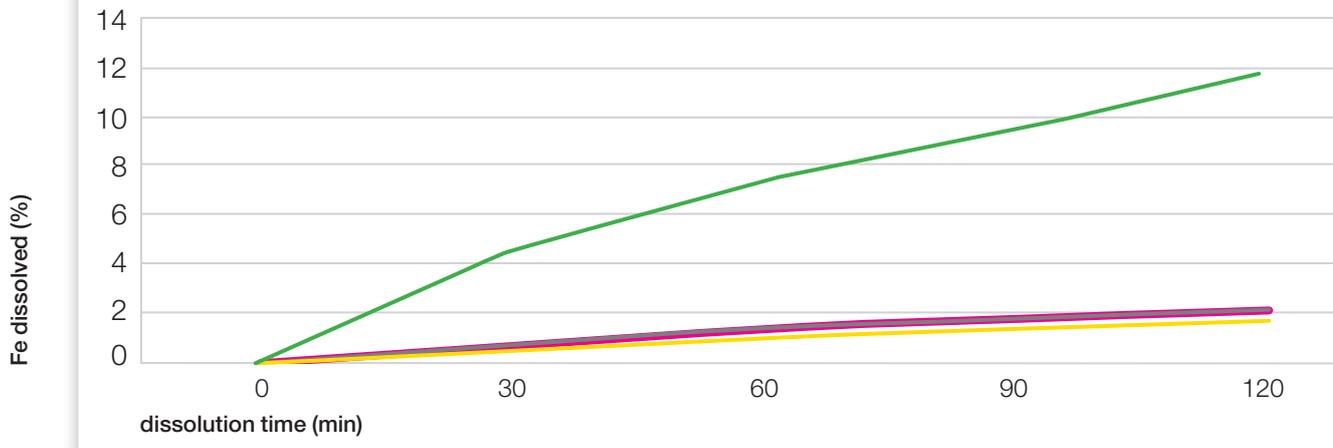
## Conclusion

- ◆ The melting areas vary between 50 °C and 70 °C
- ◆ All fat coatings are stomach resistant
- ◆ All fat coatings are dissolved in the intestine

**Release of Ferrous Sulfate with different capsule materials in simulated gastric solution, 37 ± 0.5°C (Fig. 3a)**



**Detailed view on the release of Ferrous Sulfate with different capsule materials in simulated gastric solution, 37 ± 0.5°C (Fig. 3b)**



- Ferrous Sulfate without capsule
- Ferrous Sulfate encapsulated with non-hydrogenated palm oil (Product no. 522005995)
- Ferrous Sulfate encapsulated with hydrogenated palm oil (Product no. 522005910)
- Ferrous Sulfate encapsulated with hydrogenated rapeseed oil (Product no. 522005974)
- Ferrous Sulfate encapsulated with hydrogenated sunflower oil (Product no. 522005975)

# Product Portfolio

Product	Product no.	Quality*	Coating material	Active ingredient/encapsulation	Metal content	Color	Melting point
<b>Microencapsulated products</b>							
Copper(II) Gluconate	519025900 519025910	FCC	hydrogenated palm oil	50/50	approx. 7 % Cu	light blue	60–63 °C
Copper(II) Sulfate 1-hydrate	511048005	chem. pure	hydrogenated palm oil	50/50	approx. 17.5 % Cu	greenish white	60–63 °C
Ferrous Fumarate	505025970	Ph.Eur.   BP   USP   FCC	hydrogenated palm oil	60/40	approx. 19 % Fe(II)	reddish-brown	60–63 °C
	505025960		hydrogenated palm oil	50/50	approx. 16 % Fe(II)		60–63 °C
	<b>NEW</b> 505025972		hydrogenated rapeseed oil	60/40	approx. 19 % Fe(II)		68–74 °C
	<b>NEW</b> 505025974		hydrogenated rapeseed oil	50/50	approx. 16 % Fe(II)		68–74 °C
	<b>NEW</b> 505025973		hydrogenated sunflower oil	60/40	approx. 19 % Fe(II)		69–73 °C
<b>NEW</b> 505025975	hydrogenated sunflower oil	50/50	approx. 16 % Fe(II)	69–73 °C			
Ferrous Sulfate, dried	522005910	Ph.Eur.   BP   USP   FCC	hydrogenated palm oil	50/50	approx. 16 % Fe(II)	off-white/yellowish	60–63 °C
	522005995		non-hydrogenated palm oil				59–64 °C
	<b>NEW</b> 522005974		hydrogenated rapeseed oil				68–74 °C
	<b>NEW</b> 522005975		hydrogenated sunflower oil				69–73 °C
Magnesium Oxide	503046020	Ph.Eur.   BP   USP   FCC   E 530	hydrogenated palm oil	60/40	approx. 35 % Mg	white to off-white	60–63 °C
Manganese(II) Sulfate 1-hydrate	512014950		hydrogenated palm oil	50/50	approx. 16 % Mn	white to off-white	60–63 °C
Zinc Citrate	502017009	chem. pure	hydrogenated palm oil	60/40	approx. 19 % Zn	white	60–63 °C
Zinc Oxide	515007950	Ph.Eur.	hydrogenated palm oil	50/50	approx. 40 % Zn	white to off-white	60–63 °C
	515007960	FCC					
<b>Micro2 – micronized and microencapsulated products</b>							
Ferrous Sulfate, dried, Micro2	522005985	Ph.Eur.   BP   USP   FCC	hydrogenated palm oil	30/70	approx. 10 % Fe(II)	off-white/yellowish	60–63 °C
Ferric Pyrophosphate, Micro2	505064985	FCC	hydrogenated palm oil	30/70	approx. 7 % Fe(III)	yellowish	60–63 °C
<b>Matrix encapsulated products</b>							
Ferric Pyrophosphate	<b>NEW</b> 505064009	FCC	maltodextrin	50/50	approx. 12.5 % Fe(III)	yellowish	–

On request, it is possible to work on further Mineral Salt and coating material combinations.

\* Active ingredient

## References

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## Dr. Paul Lohmann® – Your Partner for high value Mineral Salts

With over 130 years of producing mineral salts that meet the highest quality standards we have been established as the leading global supplier to the pharmaceutical, biopharmaceutical, nutritional supplement, food and personal care industries.

### Our Expertise

- ◆ GMP and DIN EN ISO 9001:2015 certified production sites
- ◆ FSSC 22000/ISO 22000 certified
- ◆ Processes according to HACCP
- ◆ Successfully inspected production site in Emmerthal by FDA (U.S. Food and Drug Administration) in the context of FSMA (food safety modernization act)
- ◆ Tailor-made and innovative solutions according to customer requirements
- ◆ Highly qualified experts in R&D lab and application technology with long-term experience and a wide variety of possibilities to develop new products and applications
- ◆ Joint product and application development together with our customers
- ◆ Our manufactured products are exclusively Made in Germany
- ◆ A wide range of more than 400 different mineral salts
- ◆ Products in compliance with the most relevant pharmacopoeias (Ph.Eur., USP, BP), food codices (FCC, E-numbers, etc.) and customer specific requirements
- ◆ Regulatory documentation (CEP, ASMF, etc.)
- ◆ REACH compliance on request
- ◆ Wide range of production equipment
- ◆ Social and environmental standards (DIN EN ISO 50001, Sedex)
- ◆ High purities can be realized according to specific requirements

### Modification

- ◆ Physical properties
- ◆ Chemical properties
- ◆ Packaging
- ◆ Labeling

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