

# Catalyst Carrier

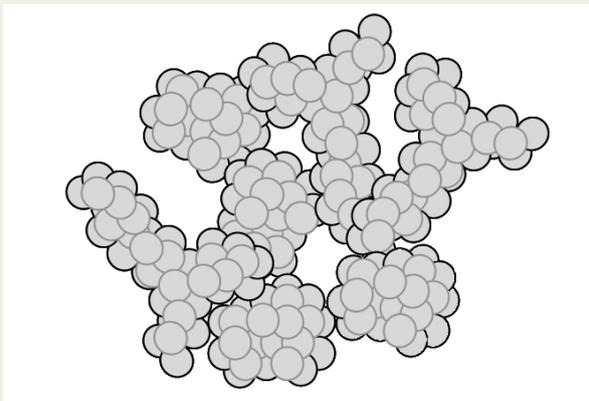
Newsletter

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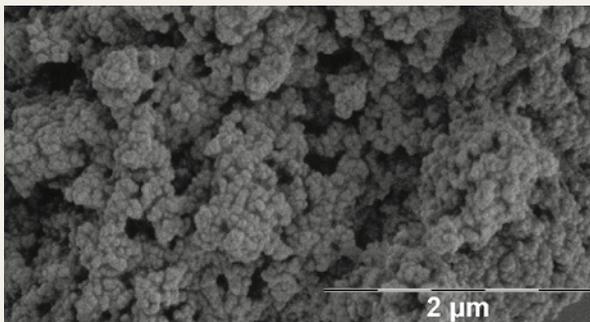
## Designing Porous Particles

### 1 Specialty Silica Fundamentals

SIPERNAT® Specialty Silica are produced by acidification of an aqueous alkali silicate solution. The primary particles, which are initially generated, subsequently form aggregates and agglomerates. This leads to sponge-like structures and particle sizes typically in the micrometer range. Figure 1 illustrates schematically the structure of Specialty Silica and Figure 2 features a micrograph of a typical SIPERNAT® Specialty Silica surface, showing the sponge-like agglomerate structure with numerous pores of different sizes.



**Figure 1**  
Structure of Specialty Silica

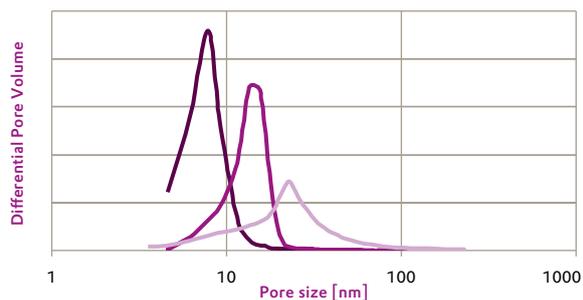


**Figure 2**  
SEM Image of Surface and Pore Structure of Specialty Silica

### 2 Designing Porosity

For silica-supported catalyst applications, the specific surface area of the silica is highly important. We have addressed the need for high surface area silica types with our products SIPERNAT® 50 and SIPERNAT® 310. They show a specific surface area of 500 m<sup>2</sup>/g and 700 m<sup>2</sup>/g respectively; however, these grades are best characterized as classical Specialty Silica and thus show a broad pore size distribution with part of the surface area to be found in the micropore range. Under further processing (such as extrusion and calcination) of these silica grades a significant fraction of the micropores, and hence surface area, will be lost. To address this at times limiting phenomenon, Evonik has specifically designed a class of mesoporous Specialty Silica types.

Three examples of these mesoporous silica grades are EXP 4210-1, 4215-1 and 4230-1. They combine a well-defined pore size distribution, which is usually found in silica gels, with the good processability of Specialty Silica during granulation or extrusion. Figure 3 shows the pore size distribution of these three experimental silica grades.

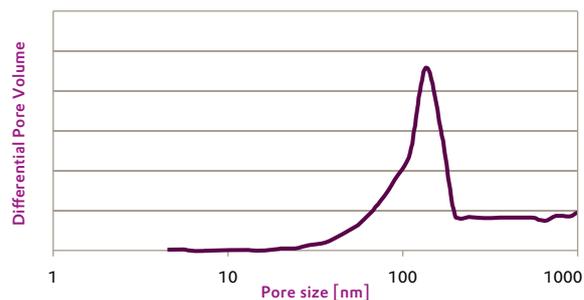
**Figure 3**Pore size distribution (N<sub>2</sub> desorption) of mesoporous EXP grades

— EXP 4210-1    — EXP 4215-1    — EXP 4230-1

Another unique type of Specialty Silica is SIPERNAT® 350. This macroporous grade is ideally suited whenever large molecules such as biocatalysts need to be fixed on a silica support. Figure 4 shows the pore size distribution of this grade (measured by Hg intrusion).

**Figure 4**

Pore size distribution (Hg intrusion) of SIPERNAT® 350



### 3 Product Overview

A selection of recommended grades and their typical properties is given below. These data should be seen only as an example; further variation, according to the customers need, is possible. Contact us. Challenge us.

### 4 Conclusion – SIPERNAT® Specialty Silica

Because Evonik can design the pore structure of SIPERNAT® Specialty Silica by carefully controlling the reaction conditions, a wide portfolio of products is available to meet our customers' needs. Look to the SIPERNAT® trade name for a broad range of Specialty Silica grades with different particle morphologies, surface areas and well adjusted pore size distributions.

**Table 1**

Properties of selected silica types. The values given are typical data and not part of the specification.

Silica Grade	Specific surface area (N <sub>2</sub> ) TriStar Multipoint following ISO 9277 [m <sup>2</sup> /g]	Particle Size, d50 Laser diffraction following ISO 13320-1 [μm]	Description
EXP 4210-1	560	< 20	EXP 4210-1 is a mesoporous silica with high surface area and an average pore size in the 10 nm range.
EXP 4215-1	350	< 30	EXP 4215-1 is a mesoporous silica with medium surface area and an average pore size in the 15 nm range.
EXP 4230-1	290	< 10	EXP 4230-1 is a mesoporous silica with medium surface area and an average pore size in the 20 nm range.
SIPERNAT® 50	500	50	SIPERNAT® 50 is a high surface area silica with a wide pore size distribution.
SIPERNAT® 310	700	8.5	SIPERNAT® 310 is a high surface area silica with a wide pore size distribution.
SIPERNAT® 350	55	4.5	SIPERNAT® 350 is a macroporous silica with low surface area and an average pore size in the 150 nm range.

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