填料让您的笑容更加灿烂
Fillers for a radiant smile

Hidden inside – Performance outside!

HPF **Minerals Ltd.**

A SUBSIDIARY OF THE QUARZWERKE GROUP

牙科印模材料
dental impression material

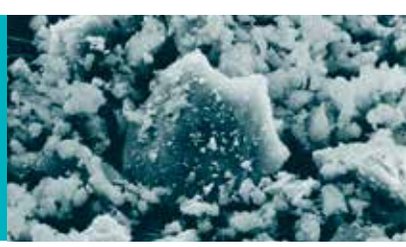
一段时间以来，填料远不止是稀释聚合物的低成本材料。填料的使用能够有针对性地改变聚合物体系的特性，并可根据特殊要求对其进行调整。

For some time fillers are far more than only economical materials for diluting polymers. By applying fillers the characteristics of the polymer system can be changed purposefully and can be adjusted to special requirements.

HPF The Mineral Engineers 已为硅胶和聚醚基牙科印模材料以及复合材料开发出多种高性能填料。

HPF The Mineral Engineers has developed a variety of High Performance Fillers for use in both silicone and polyether based dental impression materials as well as composites.

用于硅胶印模材料的方石英
Cristobalite for silicone impression material



方石英是石英的一种高温改性材料。它是通过将石英加热至1000°C 以上制成。通过煅烧得到一种具有出色亮度且微生物无害的矿物。方石英细粉和超细粉是硅胶牙科印模材料的理想原料。

Cristobalite is a high-temperature modification of quartz. It is made from pure silica by heating it up to more than 1,000 °C. As a result of this calcining-process a microbiological harmless mineral with outstanding brightness is obtained. Cristobalite fine and ultra fine flours are the ideal base for silicone dental impression materials.

合适的填料可以使印模材料在可接受的粘度下达到较高填充度。因此，可最大限度减少反应过程中的收缩，实现浇铸物最高精度。通过使用这种非常白的方石英，化合物可以获得出色的着色力和所需的弹性以及肖氏硬度。
需要强调的是，这里所描述的石英和方石英粉末都含有极少量的粗颗粒。粗颗粒的存在对实现功能至关重要。

The selection of suitable fillers enables a very high filling degree with acceptable viscosity of the impression compounds. That way the highest possible precision of the casting compound can be realized by minimisation of shrinking during reaction. An excellent colouring power and desired elasticity as well as shore hardness of the compound can be achieved by application of this very white cristobalite.
It is to be emphasised that all quartz and cristobalite powders, as described here, contain a very low fraction of coarse particles. This is crucial for the functionality of the application.

牙科用方石英细粉和超细粉的特性概述：

Overview of properties of cristobalite fine and ultrafine flours for dental applications:

- 高亮度
- 无磨损加工
- 粒度分布窄，且经优化
- 微生物无害
- 可提供特殊的表面处理

- *high brightness*
- *abrasion-free processing*
- *narrow grain size distribution, coarse grain optimised*
- *microbiological harmlessness*
- *specially adapted surface treatment available*

SIKRON® 和 SILMIKRON® – 用于牙科无表面处理的方石英粉

SIKRON® und SILMIKRON® – untreated cristobalite flours for dental applications

	Parameter 参数	SIKRON® SF 3000	SIKRON® SF 4000	SIKRON® SF 6000	SILMIKRON® 805-10/1
Körnung 粒度	d_{10} (µm)	1,5	1,5	1,0	0,2
	d_{50} (µm)	6,0	5,0	3,5	0,5
	d_{90} (µm)	19,0	15,0	9,0	1,0
Farbe 颜色	X/D65	91,5	92,1	92,5	92,0
	Y/D65	96,5	97,2	97,0	97,0
	Z/D65	103,8	104,6	105,1	104,0
	pH-Wert *pH* 值	8,2	8,2	8,2	8,5
	Oberfläche (m^2/g) 比表面积 *(m^2/g)*	3,0	4,0	5,0	20

HPF Minerals Ltd.

卓越的加工性能
Excellent processability

表面处理可实现填料和聚合物之间的最佳相互作用

SILBOND® 产品系列是表面处理的方石英细粉，专为 RTV2型硅胶印模材料而开发。恰当的表面处理可确保填料与聚合物最佳作用，实现良好的加工性能。即使高填充度也能实现对粘度的完美调节 。

表面处理的类型可通过粒度特征数字后的三个字母来识别：

MST 甲基丙烯酸硅烷
RST 三甲基硅烷

Surface treatment for optimum interaction between filler and polymer

Surface treated cristobalite fine flours of the product line SILBOND® have especially been developed to be employed in silicone impression materials type RTV2. The surface treatment specially adapted to the polymer system has been applied to the filler in order to guarantee an optimum bond to the binder and to enable an excellent processability. A perfect adjustment of the viscosity at high filling degrees is achieved as well.

The type of surface treatment is defined by the following threeletter code added to the characteristic grain data:

MST treated with Methacrylsilane
RST treated with Trimethylsilane

	Parameter 参数	SILBOND® 3000 RST	SILBOND® 6000 RST	SILBOND® 8000 RST	SILMIKRON® 805-10/1 RST
Körnung 粒度	d_{10} (µm)	1,5	1,0	1,0	0,2
	d_{50} (µm)	6,0	3,5	2,5	0,5
	d_{90} (µm)	19,0	9,0	6,0	1,0
Farbe 颜色	X/D65	91,0	92,0	92,0	92,0
	Y/D65	96,0	97,0	97,0	97,0
	Z/D65	104,0	104,0	104,0	104,0
	pH-Wert *pH 值*	8,5	8,5	8,5	8,5
	Oberfläche (m^2/g) 比表面积 *(m^2/g)*	3,0	5,0	8,0	17

SILBOND® 和 SILMIKRON® – 用于 RTV2 型硅胶印模材料
SILBOND® and SILMIKRON® – for silicone impression material type RTV2

总结

精确的印模和优化的制模时间
SILBOND® 方石英细粉可确保高度精确的铸模。对于患者和牙医来说非常重要的制模精度和制模时间针对粘合剂得到了优化。

为患者提供理想的感官质量
通过在无磨损研磨装置上进行彻底的清洁和无铁研磨，防止了污染的发生。此外，高效的空气分离可以很好地限制较粗颗粒的含量。这保证了一致的理想感官质量，这对患者来说是很重要的。

Summary

Precise impression and optimized moulding time
In using SILBOND® cristobalite fine flours highly accurate casts can be obtained. The very important balance between the exactitude and the length of time for the moulding process for both patient and dentist is optimized in regard of the binder.

Ideal sensory quality for the patient
Contaminations are prevented through extensive cleaning- and iron-free grinding processes on abrasion-free milling units. Furthermore highly efficient air separation allows an optimum limitation of coarser grain fractions. Thus a consistent and ideal sensory quality, which is important for the patients, is assured.

牙科复合材料使用甲基丙烯酸酯，如双酚 A 甲基丙烯酸缩水甘油酯（bis-GMA）和三甘醇甲基丙烯酸二甲酯（TEGDMA）作为基本单体。这些单体根据具体的应用填充有不同的填料。另外，根据不同的应用，玻璃、石英或陶瓷被用来减少聚合物的收缩，改善机械性能，调整光学性能或改善 X 射线的可见度。

Dental composites consist of methacrylates such as bisphenol-A glycidyl methacrylate (bis-GMA) and triethylene glycol dimethyl methacrylate (TEGDMA) as base monomers. The monomers in question are filled with different fillers depending on the application. Also depending on the application, glasses, quartz or porcelain are used to reduce polymer shrinkage, improve mechanical properties, adjust optical properties or improve X-ray visibility.

牙医使用牙科复合材料密封牙釉质中的洞或裂缝，它由填料和含改性丙烯酸酯的有机物组成。牙科复合材料主要是通过紫外线固化。因此，所用填料必须匹配有机基底的折射率 (1.52-1.53)。以确保即使是很厚的材料也能固化。

Dental composites are used by the dentist to seal cavities or cracks in the enamel and are composed of fillers and an organic matrix consisting of modified acrylates. Dental composites are predominantly UV-curing. For this reason, it is crucial that the fillers used have a refractive index suitable for the monomer mixtures (1.52-1.53). This ensures that even high layer thicknesses can be cured.

用于牙科复合材料的长石
Feldspar for dental composites

MICROSPAR® 1351 系列的长石产品是标准填料的完美替代品。它们可以在固化的复合材料中提供相同甚至更好的机械性能。

The feldspar products of the MICROSPAR® 1351 series represent a perfect alternative to the standard fillers used. They provide the same or better mechanical properties in cured composites.

在可开采地壳中，长石含量约占60%总重，是最常见的矿物群。长石是一种耐化学腐蚀的硅酸盐，是具有厚板状的颗粒。HPF 生产钾长石和钠长石，采用复杂的加工技术对它们进行分离、分类和精细研磨。

With almost 60% by weight of the accessible earth crust, feldspars are by far the most common mineral group. Feldspar is a chemically resistant silicate with a thick slated grain morphology. HPF produces both potash and soda feldspar, which are separated, classified and finely ground using complex processing techniques.

特性：

- 高白度
- 耐化学性
- 在高分子材料中透明
- 低折射率

Properties:

- *High degree of whiteness*
- *Chemical resistance*
- *Transparent behaviour in the binder system*
- *Low refractive index*

下表显示了所测试的类型及其各自的特性。不同的填充度是在所有填料的加工粘度相同的情况下产生的。

The types examined are shown in the following table with their respective properties. The different filling degrees result from the same processing viscosity for all fillers.

除了标准牌号，MICROSPAR®特殊牌号可供选择。特殊工艺处理可降低材料表面第二族元素含量（MST-S）， 提高复合材料的储藏稳定性。MICROSPAR®产品表面处理后，可使填料与聚合物基质更优结合。硅烷含量可调，但推荐使用基础版本以避免机械性失效。产品名称中的 MST 是指甲基丙烯酸硅烷表面处理。

In addition to the standard grades, other MICROSPAR® grades are offered which have undergone a special process and have a low content of secondary group elements on the surface (MST-S). This can have a positive effect on the storage stability of the composites. All MICROSPAR® products have a surface coating that enables optimum integration of the filler into the polymer matrix. Silanisation is possible at different levels, but our basic version is recommended to avoid mechanical failure. The designation -MST in the product name refers to a coating with methacrylic silane.

所测试的产品及其特性概述
Overview of products and properties investigated

Parameter 参数	MICROSPAR® 1351-600 MST	MICROSPAR® 1351-900 MST	牙科玻璃 | *dental glass* 3 µm MST
d50 [µm]*	3,50	0,70	3,0
BET [m^2/g]**	3	15	2,3

*激光衍射 | *laser diffraction* **典型值 | *typical values*

Parameter 参数	MICROSPAR® 1351-600 MST-S	MICROSPAR® 1351-900 MST-S
d50 [µm]*	3,50	0,80
BET [m^2/g]**	11	18

*激光衍射 | *laser diffraction* **典型值 | *typical values*

复合材料的制作

MICROSPAR® 1351 与双酚 A 甲基丙烯酸缩水甘油酯（bis-GMA）和三甘醇甲基丙烯酸二甲酯（TEGDMA）混合。bis-GMA/TEGDMA 混合比例为 80/20，樟脑醌和甲基丙烯酸2-二甲氨基乙酯作为光引发剂。使用 Speedmixer 分散填料。

Production of composites

The considered MICROSPAR® 1351 grades were incorporated into a mixture of bisphenol A glycidyl dimethacrylate (bis-GMA) and triethylene glycol dimethyl methacrylate (TEGDMA). The mixing ratio bis-GMA / TEGDMA was 80/20, and as the photoinitiator system, camphorquinone and 2-dimethylaminoethyl methacrylate were used. The incorporation of the filler was carried out by means of Speedmixer.

三点弯曲测试试样制备

根据 ISO 4049 测量固化后复合材料的弯曲强度。复合材料的固化通过 Heraeus HiLite Power 进行，持续时间为 90 秒，辐照试样双面。脱模后的试样在 37°C 去离子水中储存 24 小时。对试样施力直至断裂，记录断裂时施加的力。

Production of the three-point bending test specimens

The flexural strength of the cured composites was determined according to ISO 4049. The curing of the composites was carried out by means of Heraeus HiLite Power for 90 seconds. The specimens were irradiated on both sides. After demoulding the specimens they were stored for 24 h at 37 ° C in de-ionized water. Subsequently, the test specimens were loaded until breakage and the force applied at break was recorded.

填料 *filler*	填充度 [重量 %] *filling degree [wt.%]*	弯曲强度 [MPa] *flexural strength [MPa]*	弹性模量 [MPa] *e-modulus [MPa]*
牙科玻璃 3.0 MST	72,35	102	7851
MICROSPAR® 1351-600 MST	70,50	112	7513
MICROSPAR® 1351-600 MST-S	70,50	119	8849
MICROSPAR® 1351-900 MST	70,50	106	7605
MICROSPAR® 1351-900 MST-S	70,50	104	8275

*所有混合物的目标填充度为 51%（按体积计）。这相当于 MICROSPAR® 70.50% 的重量填充水平。因此，填充度因混合物而异。
**The target filling degree for all mixtures was 51% by volume. This corresponds to a weight filling level of 70.50% MICROSPAR®. For this reason, the degree of filling varies with the blends.*

MICROSPAR® 与牙科玻璃测试结果的比较
Test results MICROSPAR® compared to dental glass

测试表明，含 MICROSPAR® 的复合物的机械学强度高于含市售牙科玻璃的复合物。

由于 MICROSPAR® 的低不透明度（35%），所以同时测试了市售牙科玻璃。混合物的不透明度的测试仍在进行，在此提供计算值（见表）。使用的牙科玻璃的不透明度为 480%，含MICROSPAR® 的复合物不透明度为 35%。

The tests showed that the mechanical strengths of the products manufactured with MICROSPAR® are higher than those of a commercially available dental glass.

Since MICROSPAR® only has a very low opacity (35%), tests were also carried out with blends with commercially available dental glass. The already mentioned above dental glass was used. The results of the examination of the opacity of the blends are still pending and were therefore calculated in advance (see table). The dental glass used has an opacity of 480%, that of the MICROSPAR® is 35%.

混合物起着决定性作用
It depends on the mixture

填料 *filler*	填充度 [重量 %] *filling degree [wt.%]*	弯曲强度 [MPa] *flexural strength [MPa]*	弹性模量 [MPa] *e-modulus [MPa]*	计算出的不透明度 [%] *calculated opacity [%]*
50/50 牙科玻璃 / 1351-600 MST	71,50	114	8599	185
80/20 牙科玻璃 / 1351-600 MST	72,00	109	8387	282
50/50 牙科玻璃 / 1351-600 MST-S	71,50	105	8036	185
80/20 牙科玻璃 / 1351-600 MST-S	72,00	107	8635	282
50/50 牙科玻璃 / 1351-900 MST	71,50	90	7680	185
80/20 牙科玻璃 / 1351-900 MST	72,00	106	8078	282
50/50 牙科玻璃 / 1351-900 MST-S	71,50	118	8691	185
80/20 牙科玻璃 / 1351-900 MST-S	72,00	107	8070	282

*所有混合物的目标填充度为 51%（按体积计）。这相当于 MICROSPAR® 70.50% 的重量填充水平。因此，填充度因混合物而异。
**The target filling degree for all mixtures was 51% by volume. This corresponds to a weight filling level of 70.50% MICROSPAR®. For this reason, the degree of filling varies with the blends.*

结论

- 添加适量的牙科玻璃可以显著改善MICROSPAR® 产品的不透明度。
- 与单纯使用牙科玻璃相比，使用混合填料的复合材料拥有更高的弯曲强度。

Conclusion

- *The addition of appropriate dental glass significantly improves the opacity of MICROSPAR® products.*
- *The mechanical properties of the composites with the blend tend to show better flexural strengths than the mere use of a dental glass.*

填料专家

Quarzwerke 集团作为一家家族企业，生产矿物原料已有 135 多年的历史。集团专注于从优质矿床中提取、加工和精炼工业矿物：石英、高岭土、长石、硅灰石和云母被加工成 700 多种高质量的产品，并销往 50 个国家。我们坚持可持续战略，拥有现代、高效的加工设备。

HPF The Mineral Engineers 是 Quarzwerke 集团的一个部门，着眼于未来在矿物和合成基础上开发创新、功能性的高性能填料和添加剂。高性能填料给聚合物体系带来了惊人的功能和/或光学特性。我们在数十年经验的基础上开发独特的系统解决方案。我们在客户的产品方面对自己提出越来越严格的要求。

我们在矿物原料加工和精炼方面的丰富经验使我们能够一次又一次成功地应对这些挑战：我们为客户开发和提供针对聚合物体系的定制填料解决方案。

Quarzwerke 坚持贯彻脚踏实地的质量理念，通过了 DIN EN ISO 9001 认证，确保提取到交付整个过程无误。DIN EN ISO 14001 认证证明了 Quarzwerke 兼顾一切的环境管理体系。

Expertise in fillers

The Quarzwerke Group has been producing mineral raw materials for over 135 years as a family business. The focus is on extraction, processing and refining of industrial minerals from high-quality deposits: Quartz, kaolin, feldspar, wollastonite and mica are processed into more than 700 different quality products and sold in 50 countries. We are ecologically sustainable and rely on modern and efficient processing.

HPF The Mineral Engineers is a division of the Quarzwerke Group, which is looking toward the future with the development of innovative and functional high-performance fillers and additives on a mineralogical and synthetic basis. High-performance fillers impart amazing functional and/or optical properties to polymer systems. We develop unique system solutions based on our decades of experience. The demands placed on our customers' products are constantly increasing.

Our extensive experience in the processing and refining of mineral raw materials enables us to successfully master these challenges again and again: We develop and deliver tailor-made filler solutions for polymer systems to our customers.

Quarzwerke is a company with a highly convincing quality philosophy, certified in compliance with DIN EN ISO 9001, so that everything runs without a hitch from extraction to delivery. The successful implementation of DIN EN ISO 14001 proves that Quarzwerke exhibits a holistic environmental management.

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Hidden inside – Performance outside!

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