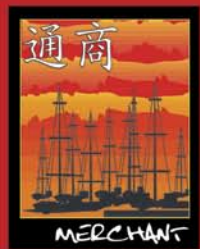


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硅树脂加工添加剂具有独特的灵活性及兼容性，
已成为纸浆、生活用纸生产的关键成分
撰文/ 大卫·威尔逊博士

硅树脂的用途



Silicone's applications

Silicone's flexibility and compatibility is making it a key ingredient for pulp and tissue manufacturing
By Dr David Wilson

一般称为硅树脂的材料在纸浆和生活用纸化学药品之中都具有独特的结构，带有有机及无机化学的元素。硅树脂可用于乳化液、浓缩液、化合物及装入胶囊的粉末等多种物理形式之中，适合于所用运输系统。

由于双重的有机和无机趋势，硅树脂可以通过各种不同的方法加以利用，而且可以和大量有机或合成材料相结合。通过把不同功能的物质转移到硅树脂支柱中，就可能创造出具有特殊特征的分子结构。其结果就是各种高效性能添加剂及加工辅助。这种多功能性也允许开发定制产品配方，以适应特殊性能和加工标准。纸浆、生活用纸配方设计师给其造纸厂顾客在加工过程中选择现成乳化液或浓缩液的自由。

The materials known generically as silicones have a unique structure among pulp and tissue chemicals, with elements of both organic and inorganic chemistry. Silicones are available in several physical forms such as emulsions, concentrates, compounds and even encapsulated powders providing options to suit virtually any delivery system.

Because of their dual organic and inorganic tendencies, silicones can be manipulated in a variety of ways, and can be combined with a broad range of organic or synthetic materials. By grafting different functional groups onto the silicone backbone, it is possible to create molecular structures

大部分配方设计师对硅树脂性能添加剂的排水性或恐水性都有很深的印象。硅树脂化学药品也还提供多种变异与化合，包括亲水性材料与具有多种特性组合的产品，帮助实现所有应用的最佳平衡。

特殊性能添加剂可以改善柔软性、抗水性、吸水性和耐热性等多个方面。许多产品根据个性化配方都可以提供其中部分优点。

硅树脂提供许多重要的洗浆物理性质，包括最佳用途、浸湿、耐热性及与多种其它纸业化学药品的全面兼容性。例如，硅树脂聚醚是高表面活性硅树脂材料，可以作为高效表面活性剂用于洗浆配方之中，由于其表面活性本质，可以改善纸浆排水性。

硅树脂最常见的用途之一是其非凡的泡沫控制能力。硅树脂防沫剂在泡沫介质中不溶解，而且有能力进入泡沫层，并在其中扩散，干扰泡沫稳定性，引起气泡合并。在牛皮纸和亚硫酸盐业务中，根据不同加工条件已经开发出多种不同的产品，在浓度、黏性、泡沫分解和持久性方面提供多种选择。

一般情况下，硅树脂的有效浓度远低于矿物油性防沫剂，其活性成分用量标准仅为油性添加剂的1/3到1/30。除控制泡沫外，硅树脂还提高材料冲洗槽中的排水，增强冲洗效率，降低苏打损失和蒸汽消耗水平，还可以通过进入漂白车间黑液的缩减降低纸浆漂白成本。另外，适当配方与测量的硅树脂加工辅助不可能留下残余物，这些残余物妨碍下游造纸机的操作及随后的印刷或涂料操作。

作为蒸煮器添加剂，硅树脂在制浆期间提高了蒸煮液进入木屑的穿透性，降低蒸煮过程中的蒸煮温度或活性碱。蒸煮温度越低，需要的能源电力也就越低；减少使用活性碱，液可以降低纤维裂解，从而提高纸浆的物理性能，尤其是撕裂强度。

硅树脂化合物是防沫剂配方中的主要成分。这些化合物通常由含有细小的粉末硅石分布的硅油构成，可以提高去沫效率。对于无水系统，100%活性硅树脂浓缩液已经被开发出来，作为油性配方中的主要成分，满足化学制浆操作中遇到的严格泡沫控制等要求。

浓缩液被认为是硅树脂化合物及其它重要成分的结合。配制的这些成分在化学药品配方设计师和纸浆厂选择的运输系统中提供最佳性能。含有硅树脂浓缩液的无水去沫剂能够提供许多性能优

Environmental stewardship is another advantage of silicone emulsions

that yield specific characteristics. The result is a wide array of highly effective performance additives and process aids. This versatility also allows the development of customised product formulations to suit specific performance and processing criteria. Pulp and tissue formulators provide their mill customers the freedom to select a ready-to-use emulsion or a concentrate to meter into their process.

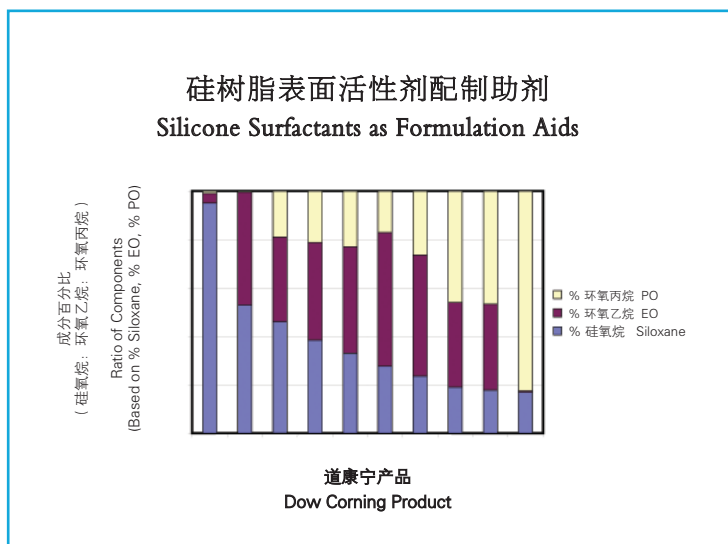
Most formulators have an image of silicone performance additives as being water repellent or hydrophobic. Silicone chemistry also offers many other variants and combinations, including hydrophilic materials, as well as products that offer a combination of properties to help achieve an optimum balance for any given application.

Specific performance additives deliver improvements in softness, water repellency, absorbency and temperature stability. Many products offer a number of these benefits, depending on the individual formulation.

Silicones offer a number of important physical characteristics for pulp washing, including excellent application, wet-out, thermal stability and broad compatibility with a wide range of other paper chemicals. For example, silicone polyethers are highly surface-active silicone materials that can be used in pulp washing formulations as effective surfactants and, as a result of their surface active nature, improve pulp drainage.

One of the most common applications for silicones involves their outstanding foam control capability. Silicone antifoams are insoluble in the foaming medium and have the ability to enter the foam lamellae and spread across them, interfering with foam stability and causing bubbles to coalesce. A wide variety of products have been developed for different process conditions in both kraft and sulfite operations, offering a broad range of options in concentration, viscosity, foam knockdown and persistency.

Typically effective at far lower concentrations than competing mineral oil-based antifoams, silicone usage levels can range from 1/3 to 1/30 of the active ingredient volume required from oil-based additives. In addition to providing foam control, silicones enhance drainage on the stock washers, which results in increased washing efficiency, reduced levels of soda loss and steam consumption, and can also reduce pulp



环保性能是乳化硅油的 的另一大优点

势，在存储、处理水乳状液很不现实的用途中，这些优势与水性乳化硅油相结合。

乳状液是悬浮液中不相溶液体的稳定混合物。可以使用市场上的乳化液进行配制，使用黄原胶等多聚糖实现分散。硅树脂与大部分用于控制属性与性能的成分都可以兼容，这些成分包括硅树脂聚醚、疏水硅石、有机乙二醇及其它材料。

硅树脂加工辅助15年以前在欧洲粗浆冲洗应用方面率先使用，带来了众多下游利益，比如获得目标要求亮度等级的较低漂白化学药品要求。此外，其环境效益也是非常重要的优点之一。它们不包含可以检测到的双苯戴奥辛或二苯并呋喃，而且在其使用过程中形成无害的副产品。硅树脂在水系统中不添加生物需氧量，而且已经证实它们在废水处理业务中十分安全。



硅树脂在生活用纸加工中实现了更柔软、更光滑的感觉
Silicones achieve a softer, smoother feel in tissue converting

bleaching costs via reductions in black liquor carryover to the bleach plant. In addition, properly formulated and metered silicone process aids are unlikely to leave residues that could interfere with downstream paper machine operations as well as subsequent printing or coating operations.

As digester additives, silicones improve the penetration of cooking liquor into wood chips during pulping, which can result in reductions in the cooking temperature or active alkali content while cooking. Lower cooking temperatures, resulting in lower energy requirements combined with reductions in active alkali can together contribute to reduced fibre degradation, which can result in improved pulp physical properties, particularly tear strength.

Silicone compounds are used as key ingredients in antifoam formulations. Compounds typically consist of silicone fluids containing a very fine dispersion of powdered silica to enhance defoaming efficiency. For non-aqueous systems, 100 per cent active silicone concentrates have been developed that can be used as a key ingredient in oil-based formulations designed for aggressive foam control requirements, such as those encountered in chemical pulping operations.

Concentrates can be considered as combinations of silicone compounds with other key ingredients that are formulated to provide optimum performance in the delivery system selected by both the chemical formulator and the pulp mill. Non-aqueous defoamers that incorporate a silicone concentrate typically deliver many of the performance benefits associated with water-based silicone emulsions in applications where storage and handling of aqueous emulsions would be impractical.

Emulsions are stable mixtures of immiscible liquids held in suspension. They can be prepared using a number of commercially available emulsifiers and dispersions can be formulated using polysaccharides such as xanthan gum. Silicones are broadly compatible with other ingredients used to manipulate properties and performance, including silicone polyethers, hydrophobic silica, organic glycols and other materials.

Pioneered in Europe more than 15 years ago for brownstock washing applications, silicone process aids bring many downstream benefits such as lower bleaching chemical demand to obtain target required brightness levels. Further, their desirable environmental profile has proven to be an important benefit. They contain no detectable dibenzodioxin or dibenzofurans and form no harmful by-products as a result of their use. Silicones do not add to biological oxygen demand BOD in water systems, and they have been proven safe for wastewater treatment operations.

In tissue converting, silicones are used to achieve a softer, smoother feel and a reduced coefficient of friction, without sacrificing strength. They can also be added to modify



硅树脂化合物是防沫剂配方中的主要成分
Silicone compounds are used in antifoam formulations

在生活用纸加工中，使用硅树脂实现更柔软、更光滑的感觉，并减少摩擦系数，强度方面却没有减弱。还可以加入硅树脂改善吸水性，因为硅树脂可以按疏水或亲水配方生产。

大部分生活用纸加工的新产品是乳液。乳液成为抛光应用中运输装置的首选有许多理由，其中易于使用这个理由最为突出。与需要加热熔化的有机蜡处理不同，乳化硅油可以在室温下使用。

环保性能是水性、无溶剂乳化硅油的另一大优点。虽然它们不能生物降解，但是不挥发的硅树脂可以通过土层中进行的化学反应分解，最终自然形成硅酸硅石、二氧化碳和水等物质。纸浆和生活用纸加工过程中使用的硅树脂无毒，而且试验已经证明对植物生长或昆虫、小鸟等陆生生物都不会产生副作用。研究工作者也没有在海洋环境中发现对自由游动或沉积居住有机物有任何危险。

一些供应商已经设计了单独产品族，具体满足生活用纸加工和性能的需要，在柔软性、手感性、吸水性和强度性等方面提供众多选择。一些乳液可以让便宜的回收再利用的纤维在无损柔软性的情况下达到更高水平，有助于减少总生产成本。

道康宁公司的硅树脂产品和技术应用于制浆、涂料和回收再利用等很多方面，集中于提高最终产品的性能及加工，有助于降低成本、提高生产率。该公司与纸业化学药品配方设计师合作，提供定制技术软件包，帮助客户满足具体需求。

硅树脂可以最大限度地提高加工效率，实现在单个配方产品中的许多利益。根据其通用的化学性质、外观和运输系统，以及诱人的环境效益，硅树脂很可能扩大其在纸浆、纸张及生活用纸等领域的使用率。

大卫·威尔逊博士任职于道康宁公司欧非纸浆及生活用纸事业部

absorbency, since silicones can be manufactured as either hydrophobic or hydrophilic formulations.

Most new products for tissue converting are emulsions, which have become the preferred delivery mechanism in finishing applications for a number of reasons, particularly ease of use. Unlike organic wax treatments that require heat melting, silicone emulsions can be applied at room temperature.

Environmental stewardship is another advantage of silicone emulsions, which are water-based and solvent-free. Although

硅树脂可以提高材料冲洗槽中的排水，增强冲洗效率

they do not biodegrade, non-volatile silicones degrade through ongoing chemical reactions in the soil, ultimately forming naturally occurring substances such as silicic acid silica, carbon dioxide and water. Silicones for pulp and tissue processing are non-toxic, and testing has shown no adverse effects on plant growth or on terrestrial life forms such as insects or birds. Researchers have found no risk to either free-swimming or sediment-dwelling organisms in the marine environment.

Some suppliers have designed a separate family of products to specifically address the processing and performance needs of tissue applications, providing a range of options in softness, feel, absorbency and strength. Some of these emulsions may allow higher levels of less expensive recycled fibres without sacrificing softness, helping to reduce overall production costs.

Dow Corning's silicone-based products and technology are used for many applications, including pulping, coatings and recycling, with a focus on improving end product performance as well as processing, helping to lower costs and increase productivity. The firm has worked with paper chemical formulators and provided tailored technical packages that help customers meet specific needs.

Silicones can maximise process efficiency and achieve a number of benefits in a single formulated product. With their versatile chemistry, physical form and delivery system, as well as an attractive environmental profile, silicones are likely to find increasing utility in pulp, paper and tissue applications. ■

Dr David Wilson works for Dow Corning's European and African pulp and tissue operations



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欲知详情，请访问 www.dowcorning.com。

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