硅酮工艺

粗浆洗涤操作受益于硅酮工艺

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硅酮正越来越多地用于粗浆洗涤
Silicones are increasingly used in brownstock washing

Silicone processing

Silicone processing benefits pulp brownstock washing operations - By James Habermehl

自从1943年硅酮被商业应用以来，这种材料日益广泛应用于一系列行业及加工之中。在纸浆纸张生产及加工操作中也是如此。硅酮用于压敏标签剥离的流水作业已有多年。近年来，将硅酮在牛皮纸粗浆洗涤中作为消泡剂使用，具有重要利益。

一般情况下，常规矿质油消泡剂都包括乙烯双硬脂酰铵（EBS），这是一种类似于疏水颗粒的蜡状物。基于该技术的消泡剂已经在去除沥青沉淀上显示出重要贡献。在过渡到“白油”技术之前，矿物油消泡剂被认为是制浆厂二苯并二恶英（戴奥辛）前体的来源。

硅酮消泡剂配方中，一般使用疏水硅来替代乙烯双硬脂酰铵，它除了具有杰出的防泡沫性能外，还显示出卓越的纸浆滤水性能。洗浆机上增强的纸浆滤水具有操作灵活性，并为制浆厂在洗浆操作与漂白车间中大大节省化学药剂的开支。此外，硅酮消泡剂经过多年检测，在检测水平下并未发现有二苯并二恶英前体。

如果想更透彻了解消泡剂，则需要对泡沫的性状有一个基本了解。泡沫是气体在液体中的分散相。在大多体系下，稳定泡沫的产生出需要表面活性剂的参与。当气体进入液体时，表面活性剂在气—液接触面散开或吸收，随后，气体在液体中稳定下来。

许多因素都可影响泡沫的稳定性。消泡剂必须能够破坏气—液接触面表面活性剂层的稳定性，从而致使泡沫破裂与合并。

消除泡沫的机制十分复杂，尽管已经提出了许多种理论，但大多都被推翻了。硅酮消泡剂具有非常低的表面与界面张力，这具有更为重要的实际意义。与所替代的稳定表面活性的药剂相比，硅酮消泡剂具有更高的表面活性。硅酮消泡剂仅许在低浓度下，就可以破坏泡沫的稳定性，这使其成为矿物油产品的一个经济的替代方案。

与矿物油消泡剂一样，硅酮消泡剂与其他材料相结合起来使用，可以节省成本。为了开发高效硅酮泡沫抑制剂，专业化学配方设计师必须考虑多方面因素，这些因素包括：泡沫介质的特性、应

Since their commercial introduction in 1943, silicones have found ever increasing utility in a broad range of industries and applications. This has also been the case in pulp and paper production and converting operations. Silicones have been used for many years in pressure sensitive label release liner production. More recently, significant interest has developed in their use as a defoamer in kraft brownstock washing operations.

Conventional mineral oil-based defoamers typically contain ethylene bisstearamide (EBS), a wax-like material, as the hydrophobic particulate. Defoamers based on this technology have been demonstrated to contribute to pitch deposits. Prior to conversion to “clean oil” technology, mineral oil-based defoamers were considered as a source of dibenzodioxin precursor in the pulp mill.

Silicone-based defoamers typically use hydrophobic silica in place of EBS in their formulation and, in addition to providing excellent foam control, have demonstrated superior pulp drainage. Enhanced pulp drainage on the washers provides the pulp mill with operational flexibility along with the opportunity to gain substantial chemical cost savings in the pulp washing operation and in the bleach plant. Further, silicone-based defoamers have been tested for many years and have been found to contain no detectable levels of dibenzodioxin precursors.

A fundamental understanding of the nature of foam is required to better understand defoamers. Foam is a dispersion of a gas in a liquid. In most systems, the presence of a surface-active agent is necessary to create stable foam. The surface-active agent spreads or absorbs at the air-liquid interface,

用中的加工环境、消泡剂的成分及基础硅酮防沫化合技术的特点——这或许最为重要。

如果配方设计师没能将所有四个参数都进行考虑的话，结果有可能使生产出来的产品不能完美用于操作。

专业化学配方设计师必须首先在制浆厂操作人员的进料基础上，来决定产品的形式。产品形式既可以是硅酮水乳状液，也可以是非水的硅酮浓缩液。产品形式将确定哪种硅酮技术会最适合于应用，也包括在终产品配方里需要加入什么其它添加剂或材料。

虽然全世界都在使用硅酮浓缩液，而硅酮水乳状液却成为了制浆厂抑制泡沫的首选。用于生产硅酮水乳状液的关键活性成分通常为100%的活性硅酮防沫化合物。在最简单的配方中，硅酮防沫化合物可以是含有无水硅酸的硅酮。

当然，这些材料肯定要比它复杂得多。据Garrett所说，美国最早一项关于第一代硅酮防沫化合物的技术是在1953获得专利。此后，硅酮防沫技术已经发展至根据包括牛皮纸粗浆洗涤在内的许多不同行业的特殊需要而开发出的高度专业化的硅酮化合物。

配制成的硅酮消泡剂将所选用的硅酮防沫化合物及其他的若干种原材料相结合。这些原材料包括：水、表面活性剂、疏水颗粒以及抗微生物剂。除了对生产高效硅酮消泡剂所要求的成分进行选择之外，专业化学配方设计师还必须选择合适的工艺设备，包括反应器、混合器和生产成品的剪切设备。

在某些情况下，配方设计师可能选择将一个乳化剂配方中的硅酮防沫浓缩液来替代100%的活性硅酮防沫化合物。这样，许多相同的原材料和类似的工艺设备被用来生产成品乳化剂。随后，配方设计师必须将他们的化学配制知识同他们对粗浆洗涤工艺的认识结合起来，开发出低成本、达到所期望贮存稳定性水平防泡特性的产品。

硅酮消泡剂具有非常低的表面与界面张力，与所将替代的稳定表面活性的药剂相比，其具有更高的表面活性

硅酮消泡剂在牛皮纸粗浆洗涤操作中的应用非常成功。自上世纪九十年代初，硅酮消泡剂就已被广泛地应用于该行业。当时，许多的会议文件与专门的文章已发表，强调了消泡剂用于粗浆处理中的好处。

提到的那些重要好处包括：添加率相对于矿物油消泡剂有所下降，有关使用消泡剂的沥青沉淀的减少，显著减少、甚至完全消除了用于控制化工沥青的添加剂，使用损耗下降。

也许能够获得上述好处的两个最重要的要害是：适当的消泡剂配方及纸浆洗涤过程中最佳送料点的选择。在黑液中，液态硅酮消

formed when gas is introduced into the liquid and subsequently stabilises the gas in the liquid.

Many factors influence foam stability. A defoamer must be able to destabilise the layer of surface-active agent present at the air-liquid interface, which results in foam rupture and coalescence.

Defoaming mechanisms are complex and many theories have been proposed but have generally been disproved. Of more practical importance, silicone-based defoamers exhibit very low surface and interfacial tensions, which results in them being more surface active compared to the stabilising surface active agent they replace. Silicone defoamers are able to destablise the foam at low concentrations, which allows them to be a cost-effective alternative to mineral oil-based products.

Similar to mineral oil-based defoamers, silicone defoamers are combined or formulated with other materials to produce cost-effective products. To develop efficient silicone foam control agents, specialty chemical formulators must consider a number of factors, including: the nature of the foaming media; process conditions in the application; the form of the defoamer; and perhaps most important, the characteristics of the base silicone antifoam compound technology.

If a formulator fails to consider all four of these parameters, the resulting product is likely not to be optimised for the application.

Based primarily on input from the pulp mill operating staff, the speciality chemical formulator must determine the form of the product. It can be either an aqueous silicone emulsion or a non-aqueous silicone concentrate. The form of the product will dictate which silicone technologies are likely to be the most effective for the application and also what other additives or materials will be required in the final product formulation.

Silicone concentrates are used globally, but aqueous silicone emulsions are the predominant choice of pulp mills for their foam control needs. The key active ingredient used in the production of aqueous silicone emulsions is typically a 100 per cent active silicone antifoam compound. In the simplest form, a silicone antifoam compound can be thought of as silica-filled silicone.

Indeed, these materials are much more complex than this. One of the earliest United States patents involving first generation silicone antifoam compound technology was granted in 1953. Since then, silicone antifoam technology has evolved to the point that highly specialised silicone compounds have been developed based on specialised needs in a number of different industries, including, of course, kraft brownstock washing.

Formulated silicone defoamers combine the selected silicone antifoam compound with a number of other raw materials. These include water, surface-active agents, hydrophobic

硅酮水乳状液是制浆厂的首选
Aqueous silicone emulsions are the predominant choice of pulp mills

在纸浆与纸张生产工艺中使用任何化学添加剂的时候，都要求通过试验和误差来求出最为适宜的系统送料点

泡剂的分散，会同非液态矿物油/乙烯双硬脂酰铵产品大相径庭，了解这一点至关重要。

通常，硅酮乳状液应该添加在泡沫最成问题的工艺中。当黑液在传统旋转真空鼓式洗浆机的进浆网处泛滥时，施加硅酮消泡剂可以达到最佳特性。通常，此处混入空气最为严重，此时，添加硅酮消泡剂不妨是一个最经济的泡沫控制方案。

在纸浆与纸张生产工艺中使用任何化学添加剂的时候，都要求通过试验和误差来求出最为适宜的系统添加剂送料点。无论是对制浆厂工作人员，还是对化学配方设计师，对多送料点进行评估既麻烦又耗时。尽管如此，评估是用来确定最实效的粗浆洗涤操作方案必不可缺的一步。

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particulates and anti-microbial agents. In addition to the selection of ingredients required to produce an efficient silicone defoamer, the specialty chemical formulator must also then select appropriate processing equipment including reactors, mixers and shear devices to produce the finished product.

In some cases, the formulator may choose to replace the 100 per cent active silicone antifoam compound with a silicone antifoam concentrate in the emulsion formulation. In this case, many of the same raw materials are used as well as similar processing equipment to produce the finished emulsion. The formulator must then combine their chemical formulating knowledge with their understanding of the brownstock washing process to develop a product that provides cost-effective defoaming performance along with a desired level of storage stability.

The use of silicone defoamers in Kraft brownstock washing operations is a success story. Silicone defoamers have been used extensively in this application since the early 1990s. Many conference papers and technical articles have been published since that time highlighting the benefits of using the defoamers in brownstock applications.

The key benefits noted include reductions in addition rates relative to mineral oil-based defoamers; reductions in pitch deposits associated with defoamer usage; dramatic reductions or complete elimination of chemical pitch control additives; and lower cost in use.

Perhaps the two most important keys to obtaining the aforementioned benefits are proper formulation of the defoamer and selection of the best feed points in the pulp-washing process. It is important to understand that an aqueous silicone defoamer will disperse quite differently in the black liquor compared to a non-aqueous mineral oil-/EBS-based product.

In general, silicone emulsions should be added at points in the process where foaming is most problematic. In a conventional rotary vacuum drum washer, optimum performance will likely be obtained when feeding the silicone defoamer at the point where the black liquor overflows the washer inlet weir. Air entrainment is typically most severe at this location and addition of the silicone defoamer at this point should provide the most cost-effective foam control solution.

When running any chemical additive in a pulp and paper production process, trial and error is required to determine the optimum feed points in the system for the additive. Evaluation of multiple feed points can be inconvenient and time consuming for both the pulp mill staff and the chemical formulator, but it is a necessary step to determine the most cost-effective application programme for the brownstock washers.

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