Innovative hyperdispersants for water-based digital inks

用于水性数字墨水的创新型超分散剂

Lamberti (Gallarate, Italy)

One of the most important characteristics of Lamberti's products is their transversality, which enables them to be used in many different departments across multiple industrial sectors. Each individual product can be developed by R&D and technological centres involving many application labs.
Nowadays Lamberti's strategic role is to provide state-of-the-art technologies, as evidenced by its strong presence in innovative sectors such as grinding media and polymeric surfactants (i.e. hyperdispersant agents). In recent years the company has focused its R&D efforts on water-based hyperdispersants.
*Combining oleochemistry (surfactant), acrylic and polyurethane technologies, Lamberti has developed a new brand of polymeric dispersing agents called the **Fluijet® series**.*

- ***Fluijet® for solvent-based formulations**: The main characteristics explaining the outstanding dispersing properties of Fluijet® are its multiple chains (like the teeth of a comb) with a high affinity for the continuous phase, resulting in a high level of steric stabilization. The multiple anchoring points on the backbone of the comb assure much better coverage of the dispersed phase.*

- ***Fluijet® for water-based formulations**: Anionic comb polymers that combine acrylic and oleochemical technologies, developed by Lamberti's R&D teams to form the backbone and the teeth of the comb. Lamberti has designed products with different backbones and different types of teeth.*

The following products complete the range of additives for Lamberti's digital solutions:

- ***Printojet:** solvents & media for grinding organic and inorganic stains/pigments to a sub-micron particle size for the formulation of inkjet printing inks.*
- ***Tensiojet:** a family of special surfactants for surface tension adjustments, levelling action and anti-hydrorepellency.*

How do hyperdispersants work?

Hyperdispersant agents are polymers that combine dispersing properties with a surfactant capability. Their unique anchoring functions and stabilizing tails can be modified according to the solvent system and substrate.
Hyperdispersants have the important characteristics of improving solid particle dispersion, reducing interparticulate

Lamberti产品最重要的特点之一是其横向性，这 使其能够在多个工业领域的多个不同部门中使用。每一种产品都可以由研发中心和涉及许多应用实验室的技术中心开发。
如今，Lamberti 的战略角色是提供最先进的技术，这可以从其在研磨介质和聚合物表面活性剂（即超分散剂）等创新领域的强大影响力中得到证明。
近年来，该公司将研发工作重点放在水性超分散剂上。结合油脂化学（表面活性剂）、丙烯酸和聚氨酯技术，Lamberti 开发了名为 Fluijet® 系列的新型聚合物分散剂。

- **Fluijet® 用于溶剂型配方**：Fluijet® 出色分散性能的主要特点是其多支链（如梳齿）对连续相具有高亲和力，从而产生高水平的空间稳定性。 梳状主链上的多个锚定点确保了更好的覆盖分散相。

- **Fluijet® 用于水性配方**：由 L a m b e r i t i 的 研 发 团 队 开 发 的 阴 离 子 梳 状 聚 合 物 ，结合了丙烯酸和油脂化学的技术，来组成梳状的主链和支链。Lamberti 设计了许多具有不同主链和不同类型支链的产品。

以下的添加剂系列产品使得Lamberti数字解决方案更为完整:

- **Printojet**: 为一系列的溶剂和介质，可用于喷墨印刷墨水配方，将有机和无机染色剂/颜料研磨至亚微米粒径。。
- **Tensiojet**: 为一系列的特殊表面活性剂，用于表面张力调节、流平作用和抗疏水性调节。

超分散剂是如何起作用的?

超分散剂是结合了分散性能和表面活性剂能力的聚合物。 它们独特的锚定功能和稳定尾部可以根据溶剂系统和基质进行修改。超分散剂的重要特性是提高固体颗粒的分散性，减低分散体中颗粒间的吸引力，从 而 提高系统的稳定性。

attraction within that dispersion and improving system stability.
Stabilization is achieved through the absorption of stabilizing molecules on the surface of the particles. The repulsive forces prevent other particles from approaching close enough for the attractive van der Waals forces to cause agglomeration.

How application labs carry out R&D

Once a suitable chemical structure has been identified and its synthesis has been worked out, the application lab creates a benchmark method for evaluating them.
Due to its longstanding experience, Lamberti is well aware of the needs of technology and its partners, and can design a digital ink accordingly.
This way Lamberti can create a reference pattern (using the Properties Evaluation Method, or PEM) to screen the results of R&D.

Inkjet P.E.M. (Properties Evaluation Method)

When the ink has been obtained, the application lab implements a protocol for the purpose of evaluating the performance of the hyperdispersant through specific analysis methods, focusing in particular on ink stability.

Ink analysis:
- *Rheological analysis 0-1600 s-1 at 35-45°C*
- *Density at 25°C*
- *Particle size distribution*
- *Filtration test using Bluenco equipment at 1.5 bar constant pressure (5 and 2.5 micron polypropylene filters).*

Stability methods:
- *Turbiscan equipment: This allows any kind of destabilization process such as sedimentation, creaming and flocculation/coalescence to be detected and quantified at a very early stage. The instrument is based on Multiple Light Scattering (MLS).*
- *Litesizer equipment: This enables the stability of a colloidal dispersion to be determined by measuring the zeta potential, which is the sum of the net charge of the particle surface and the surrounding layers (at the slipping plane) and is expressed in millivolts.*
- *Static evaluation: visual checking of sediment after 2 weeks at 50°C.*

FLUIJET®

稳定能力是通过吸收粒子表面的稳定分子来实现的。排斥力可以阻止其他粒子靠近，避免引起由范德华力导致的凝聚。

应用实验室如何进行研发

一旦确定了合适的化学结构与其合成方法，应用实验室就会创建一个基准方法来评估它们。
通过这种方式，Lamberti 可以创建参考模式（使用性能评估方法/PEM）来筛选研发结果。
凭借其长期的经验和对技术与合作伙伴的了解，Lamberti能够对设计数码墨水提供帮助。

喷墨 P.E.M. （性能评价方法）

当制得墨水后，应用实验室会实施一项协议，目的是通过特定的分析方法评估超分散剂的性能，特别关注墨水的稳定性。

墨水分析:
- 流变分析0-1600 s-1 在35-45° C
- 25° C的密度
- 粒度分布
- 在1.5 bar恒压下使用Bluenco设备进行过滤测试(5和2.5微米聚丙烯过滤器)。

稳定性评价法法:
- Turbiscan 设备：这允许在很早的阶段检测和量化任何类型的不稳定过程，例如沉降、乳化和絮凝/聚结。 该方法基于多重光散射 (MLS)。
- Litesizer 设备：这可以通过测量 zeta 电位来确定胶体分散体的稳定性，zeta 电位是颗粒表面和周围层（在滑动平面上）的净电荷之和，以毫伏表示。
- 静态评估：在 50° C 下 2 周后对沉积物进行目测。

Example of a water-based ink study

In the R&D study, Lamberti identified two promising hyperdispersant agents (Fluijet W A and Fluijet W B) designed for water-based inks.
It was decided to compare their performance with a reference hyperdispersant agent.
In order to evaluate its dispersants, Lamberti focused on the stability of the inks, specifically in terms of sedimentation, particle size distribution and rheology

水性墨水研究示例

在研发过程中，Lamberti 发现了两种有前景的超分散剂（Fluijet W A 和 Fluijet WB），专为水性墨水而设计。Lamberti决定将它们的性能与参考超分散剂进行比较。
为了评估其分散剂，Lamberti重点研究了墨水的稳定性，特别是沉淀、粒度分布和流变方面。

GRINDING PROCESS DATA

DIGITAL INKS	Sample 1	Sample 2	Sample 3	Sample 4
Medium (%)	57.4	57.4	57.4	57.4
Fluijet W A Lamberti (%)	12.6	6.3		
Fluijet W B Lamberti (%)		6.3	12.6	
Reference SuperD (%)				12.6
Frit (%)	30	30	30	30
Grinding time (min)	90	90	90	90
Ink particle size d(50) (μm)	0.353	0.335	0.328	0.352
Ink particle size d(90) (μm)	0.633	0.564	0.550	0.613
Ink particle size d(100) (μm)	0.990	0.870	0.767	0.984
Viscosity at 35°C (cP)	16.1	16.3	14.4	13.3
Filtration (300gr) –pore size 2,5 micron (s)	50.5	70.5	70	60
Ink particle size d(50) after 14 days at 50°C (μm)	0.354	0.353	0.324	0.344
Ink particle size d(90) after 14 days at 50°C (μm)	0.611	0.604	0.565	0.596
Ink particle size d(100) after 14 days at 50°C (μm)	0.866	0.807	0.732	0.804
Viscosity at 35°C after 14 days at 50°C (cP)	16.3	16.2	14.6	13.1
STABILITY TESTS				
TSI (global) (1)	27	6	12.4	11.8
Mean Zeta potential (mV) (2)	-25,3	-48.3	-20	-33.5
Settling after 14 days at 50°C - Static stability test	average	No settling	low	average

Notes to table:
(1) TURBISCAN: The overall stability of inks can be calculated and quantified with the single number TSI (Turbiscan stability index); the lower the value the better the stability.
(2) LITESIZER: The higher the magnitude of the zeta potential (highly + or highly -), the more stable the colloid.

表注：
(1) TURBISCAN： 可以用单数TSI（Turbiscan稳定性指数）计算和量化墨水的整体稳定性； 值越低稳定性越好。
(2) LITESIZER： zeta电位的幅度（高+或高-）越高， 胶体越稳定

Results

Based on the P.E.M. (Properties Evaluation Method), we can affirm that the synergy between the two Lamberti dispersing agents (Sample 2) allows a water-based digital ink with the highest levels of performance in terms of stability to be obtained.
The selected evaluation methods also allow the stability of digital inks to be predicted. This statement is confirmed by the results of the static stability, Litesizer and Turbiscan tests. ✕

结果

基于 P.E.M. （性能评估方法），我们可以肯定，两种 Lamberti 分散剂（样品 2）之间的协同作用使得能够获得在稳定性方面具有最高性能水平的水性数字墨水。选定的评估方法还可以预测数字墨水的稳定性。静态稳定性、Litesizer 和 Turbiscan 测试的结果证实了这一说法。 ✕