E1.1. NUEVAS TECNOLOGÍAS Y PROCESOS DE ACABADO SOSTENIBLE

I+D DE NUEVOS ACABADOS FUNCIONALES SOBRE TEJIDOS TÉCNICOS Y PRENDAS, DE ALTO COMPONENTE SOSTENIBLE

FUN2GARMENT

FECHA 15 /12/ 2017

CONTENIDO

Este informe recoge ejemplos de nuevo equipamiento, maquinaria y procesos de acabado sostenible para la industria textil

Nivel de difusión: PÚBLICO (PU)

Documento preparado por

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1. DESCRIPCIÓN DEL CONTENIDO DEL ENTREGABLE

En este documento se recogen diversas tecnologías, equipamiento y ejemplos de maquinaria identificada para la aplicación de acabados por vía húmeda o seca, y cuya consideración principal es que promueven la sostenibilidad del propio proceso de acabado.

Ello es así porque dichas tecnologías y procesos favorecen:

- El ahorro de agua.
- Un menor consumo de productos químicos.
- Menos consumo de energía.
- La generación de menos efluentes, menos residuos o menos emisiones a la atmósfera.
- El desarrollo del proceso de acabado en un tiempo menor al habitual.

Dichas tecnologías, equipamiento y procesos han sido identificadas y estudiadas en la anualidad 2017 del proyecto IVACE FUN2GARMENT - I+D DE NUEVOS ACABADOS FUNCIONALES SOBRE TEJIDOS TÉCNICOS Y PRENDAS, DE ALTO COMPONENTE SOSTENIBLE, el cual tiene como objetivo principal desarrollar y validar nuevos procesos de acabado textil basados en láser, ozono y micronización, adaptados a tejidos de textil-hogar y prendas de uso deportivo (de origen natural o sintético) buscando tanto la funcionalización y la tecnificación del textil resultante, así como el ahorro de agua, productos químicos y energía en comparación con técnicas y procesos tradicionales de acabado como la impregnación directa, el esprayado o el dip coating.

En otros tipos de tejidos como el dénim dichas tecnologías presentan muy buenos resultados en términos de sostenibilidad de procesos y personalización de producto, pero no se tienen referencias validadas a nivel nacional de desarrollo y aplicación de las mismas sobre los tejidos y usos finales que contempla FUN2GARMENT.

Indicar igualmente que, de todas las tecnologías aquí contempladas, AITEX dispone de varias de ellas a nivel de plantas piloto, tales como la laminación hotmelt, el envejecimiento con ozono, el marcado por láser, la funcionalización por micronizado/nanoburbujas, y know-how en muchas otras de las que describe este informe.

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2. TECNOLOGÍA LÁSER

El marcado con láser sobre tejidos y prendas de fibras naturales se basa en la capacidad de sublimación de los colorantes con que se tiñen estos tejidos, por aplicación de una fuente de calor de alta intensidad. El láser tiene la capacidad de incidir a nivel nanométrico sobre las primeras capas de un material, modificando su superficie (ablación) y cuando encuentra moléculas de color estas subliman, pasando de estado sólido a gas de manera inmediata. De esta manera es capaz de 'quitar' color -incluso material- en zonas controladas, ya que los equipos de láser se manejan con un software adecuado que permite cargar diseños a la carta.

Esta potente herramienta de personalización en la industria textil viene empleándose desde hace una década sobre todo en prendas denim (jeans, principalmente), si bien es potencialmente aplicable a otros tipos de tejido (como los considerados en FUN2GARMENT) y otros bienes tales como calzado o incluso marroquinería y piel (natural o sintética). Cualquier superficie en 2D o incluso en 3D es susceptible de ser marcada con láser si el equipo está robotizado y permite diferentes movimientos.

En su uso habitual dentro de la industria del denim ha permitido la sustitución de prácticas problemáticas no solo para el medioambiente, sino también para la salud humana (ej. sandblasting o abrasión con arena que provoca problemas respiratorios en los operarios, el uso de spray de PP/permanganato potásico altamente irritante y tóxico, o el lijado manual para envejecer el denim). Además, es un proceso que permite dotar de prestaciones estéticas elevadas a los tejidos sin emplear la vía húmeda ni productos químicos para ello, con lo que no se tienen tampoco emisiones de aguas residuales generadas en el propio proceso de marcado.

Ejemplos de proveedores de esta tecnología, tanto para aplicaciones textiles como para el marcado de otros materiales son:

- JEANOLOGIA.
- TROTEC.
- TONELLO.
- EUROLASER.
- MECCO.
- LASIT.
- OT-LAS.
- ON-LASER.
- SISMA LASER.
- ALTERIA LASER.
- TRUMPF.
- LASER MARK SL.

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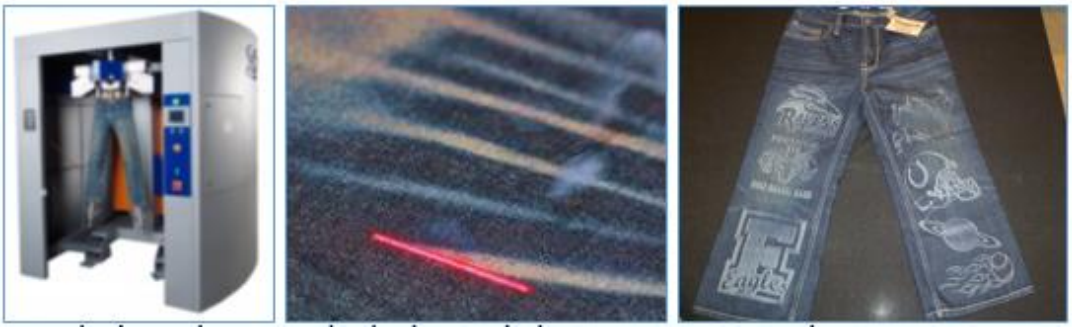

Tecnología láser aplicada al denim: izquierda) máquina de marcado 3D para jeans; centro) marcado de 'bigotes' sobre denim; derecha) jeans con diferentes efectos estéticos obtenidos por láser.

A lo largo del trabajo de investigación de documentación técnica se han identificado y analizado diferentes documentos relacionados con las posibilidades que ofrece esta tecnología para el marcado y personalización de diferentes materiales y bienes de consumo masivo. Se muestran los más relevantes y novedosos en cuanto a fecha de publicación a continuación, en formato tabulado dando título, localización del documento (número de patente, revista publicada, y fecha de publicación).

SYSTEM AND METHOD OF GENERATING A PATTERN OR IMAGE ON FABRIC WITH LINEAR LASER IRRADIATION, FABRIC MADE BY SAID METHOD, AND PRODUCTS MADE WITH SAID FABRIC		
WO/2016/033367	A method of scribing abrasion aesthetics, patterns, images, serial numbers, ply markings and/or other information, such as sizing or care information, on fabric such as denim, before or during the fabric cutting process is provided. The method comprises loading the panel abrasion software, pattern marker software, and fabric scribing software; placing the fabric on a flat surface under at least one laser; laser scribing ply numbers, serial labels, fabric markers, and panel abrasions on the fabric; cutting the fabric into fabric lengths; spreading the pre-abraded and pre-marked fabric lengths on top of each other to create multiple plies in precise alignment; cutting shaped panels along the lines of the pattern marker with a conventional knife, laser, or other appropriate cutting tool; and stacking the abraded, labeled and shaped panels robotically or manually for sewing	03/03/2016

Nº PUBLICACIÓN	**TÍTULO Y RESUMEN**	**FECHA PUBLICAC.**
HIGH SPEED AND HIGH POWER LASER SCRIBING METHODS AND SYSTEMS		
US 9,364,920 B2	A method of scribing a graphic on a material is provided, in which laser output is applied to the material. The laser output is moved relative to the material at a high speed greater than 10 m per second, and at a high power greater than 500 W, to scribe a graphic on a surface of the material. Also provided is a system for scribing a graphic on a material. The method and system of the invention are especially useful in the scribing of building materials.	JUN 2016
LASER MARKING METHOD		
US 9415463 B2	This invention provides a laser marking method that can form a very minute mark of	AGO 2016

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	a predetermined shape, such as a letter or pattern, with clarity and high solidity, on the surface of a substrate. The laser marking method of the invention comprises the steps of (1) depositing a coloring material on the surface of a substrate of thermoplastic material to form a thin film of the coloring material, and (2) applying a laser beam to the thin film of the coloring material in conformity with a predetermined marking shape to cause the portions of the substrate irradiated with the laser beam to soften and to cause the thus softened portions to mix with the coloring material, thereby developing the predetermined marking shape on the surface of the substrate.	
EFFECT OF THE CO2 LASER TREATMENT ON PROPERTIES OF 100% COTTON KNITTED FABRICS		
Cellulose April 2017, Volume 24, Issue 4, pp 1915–1926	In the textile and fashion industry, cotton knitted fabric is commonly used for making apparel. To achieve different functional effects of the cotton knitted fabric, chemical treatments are commonly used, but due to increased environmental restrictions, physical treatment, e.g., with a laser, has recently been introduced to the market as an environmentally friendly way to treat the surface of cotton fabric. Thus, the aim of the present study is to evaluate the impact of laser treatment on the physical and mechanical properties of 100% cotton single jersey knitted fabrics with different yarn counts. The fabrics had been treated using a carbon dioxide laser (CO2) with different levels of intensity in terms of the resolution and treatment time, i.e., the resolution (28, 32, 36, 40 dpi) and pixel time (100, 110, 120, 130 μs). The laser power density resulting from the different combinations of laser variables was measured. Various evaluation tests including scanning electron microscopy, fabric weight, fabric thickness and fabric bursting strength were used to study the effect of laser treatment on the knitted fabrics. Grooves and microcracks appeared on the fibers after laser treatment. With increasing resolution and pixel time, these changes became more distinct on the fiber surface. The highest number of pores was found on the yarn with a higher yarn count and lower yarn twist. According to the results of knitted fabrics treated with a laser, the largest difference was found for the aspects of weight, thickness and whiteness values of the fabric knitted with the thickest yarn. Furthermore, it was confirmed that not only the yarn count affects the change in weight and thickness, but also the fabric structure such as the number of courses affected the laser treatment result.	2017
EFFECT OF CO2 LASER ON MORPHOLOGICAL PROPERTIES OF LEATHER		
International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 02 Issue: 06 | Sep-2015	In this study we investigated, the effect of CO2 laser engraving on surface morphology of various leathers like nappa, suede, buffalo, milled and softy. The system consists of 100W CO2 laser with variable speed. The influence of power and speed of laser beam will be discussed in terms of depth of engraving, degree of etching, porosity and water vapour permeability of leathers. The CO2 Laser ablation behavior of leather is very sensitive to these parameters. The degree of etching, porosity and water vapor permeability increases with laser energy	2015
SUSTAINABLE AND ECOLOGICAL FINISHING TECHNOLOGY FOR DENIM JEANS		
AASCIT Communications Volume 2, Issue 5 July 10, 2015 online ISSN: 2375-3803	Denim Jeans finishing is an important operation for value addition of the final products in the apparel business. There are numerous operations exist for fulfilling of this treatment. This paper deals with the recent developments of the sustainable, environment friendly and emerging industrial approaches (Laser, Ozone and Water Jet) for the finishing treatments of the denim jeans. It is observed that finishing with laser and ozone is a reduced water treatment while water jet fading system though consumes water but assembling of water recycling system makes it ecological and economic. The adoption of these finishing technologies has brought about a radical transformation in the garment finishing industry, which is changing from an	2015

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	artisanal, labor intensive industry towards an industry based on knowledge and technology that feels more responsible for the environment and for workers.	
AN ANALYSIS OF SOME PHYSICAL AND CHEMICAL PROPERTIES OF CO2 LASER-TREATED COTTON-BASED FABRICS		
Cellulose January 2017, Volume 24, Issue 1, pp 363–381	The aim of this study was to investigate the feasibility of the effect of CO2 laser technology on some physical and chemical properties of cotton-based fabrics. The cotton and cotton/polyester blended fabrics used in this study were treated with different combinations of laser processing parameters, i.e., resolution (52, 60 and 68 dpi) and pixel time (110, 120, 130 and 140 μs). After laser treatment, the surface structures of the fabric samples were evaluated by scanning electron microscope. It was confirmed that pores and cracks were formed on the laser-treated cotton fibres and their sizes varied with the change of laser processing parameters. However, the change occurring on cotton/polyester blended fabrics was found to be different such that the pores of cotton fibres were covered by the melted polyester with uneven flat regions being created. The results of fabric weight and fabric thickness revealed that laser treatment altered the weight of both cotton and cotton/polyester blended fabrics. However, the fabric thickness change of cotton/polyester blended fabrics was not steady when the laser processing parameters varied. Although laser treatment reduced the whiteness of both cotton and cotton/polyester blended fabrics, the whiteness was still acceptable. In addition, the laser processing parameter could affect the tensile strength of cotton and cotton/polyester blended fabrics. Surface chemical changes of cotton and cotton/polyester blended fabrics induced by laser irradiation were observed and analysed by Fourier transform infrared spectroscopy and X-ray photoelectron spectroscopy. The results revealed that the hydroxyl C–O was found disappeared and the ether –O– stretches were reduced in both types of fabrics. Finally, it was proved by the solubility test that during laser treatment, the cotton fibres would be etched away.	2017
PROPERTIES OF COTTON FABRIC AFTER IRRADIATION WITH INFRARED CO2 LASER		
Fibers and Polymers October 2014, Volume 15, Issue 10, pp 2072–2076	Thermal effect of interaction between laser beam and fabrics presents a risk of material damage, because strong laser beam energy is applied to a very small area of fabric. At present infrared laser beam is widely applied to decolouration of denim fabrics, cutting of textiles. There were investigated the morphology, color change and mechanical properties of irradiated samples of cotton fabric. Chemical damage of cotton fibers was quantified by copper number and behaviour of dissolved polymer. Results was discussed in connection with practical applications.	2014
THE USE OF LASER IN GARMENT MANUFACTURING: AN OVERVIEW		
Nayak and Padhye Fash Text (2016) 3:5 DOI 10.1186/s40691-016-0057-x	Laser is being used in apparel industry from nineteenth century for various garment manufacturing applications. There are several advantages of using laser over the conventional processes in cutting, engraving, embossing, denim fading and other applications. In addition, product damage potential is reduced, no/less consumables are needed and no problem of toxic by-product disposal as found in some processes. Today's laser equipment is a result of continuous research and development of earlier products, which has undergone several changes. The initial laser systems were cumbersome, hard to run and difficult to maintain. However, the modern laser systems are simpler in operation and maintenance. Furthermore, the earlier systems were involved with more safety issues and needed the gasses to be constantly replenished. The garment manufactures around the globe should take the advantage of laser application in the post multi-fibre agreement regime to make their products more competitive. This review focuses on the technology of laser including various classifications. In addition it includes the applications of laser in garment manufacturing, their potential hazards and health related concerns.	2016

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TÍTULO Y RESUMEN (ARTÍCULOS)	FECHA PUBLICAC.
Merck presents new effect pigments for laser marking and rotomoulding	
German company Merck, a leading global manufacturer of effect pigments, has developed four new laser-marking pigments for plastics. According to the company, the new 'market-ready' products will open up further applications for fast, cost-effective and permanent laser markings. Merck has also launched innovative lustre pigments to enhance the visual appeal of rotationally moulded (rotomoulded) plastic products. Laser-marking pigments save time and raw materials. Incorporated directly into the final product, they create markings precisely where the beam of light is targeted, Merck explains. The company's four new offerings, which were launched in June at the Laser World of Photonics 2015 exhibition held in Munich, Germany, are additions to its existing Iriotec® 8000 series of pigments for the laser marking of plastics and print products. Iriotec 8210 pigment granules have been specifically developed for the marking of plastics that come into contact with food, Merck reports. With Iriotec 8850, thin layers can now also be laser-marked effectively. It creates fast and precise dark markings, not only in polymers, but also in powder coatings, the company says. Iriotec 8815 produces razor-sharp, light markings that create good contrasts, particularly on coloured plastics, while Iriotec 8841 – when applied in combination with the laser direct structuring (LDS) process recently patented by LPKF Laser & Electronics AG for use with Iriotec 8000 products – may have the potential 'to revolutionize the world of electronics', Merck claims. The LDS process creates 3D mechatronic integrated devices, whereby electronic circuits are directly mounted onto injection-moulded plastic or powder-coated metal parts, which then become circuit boards themselves, regardless of their shape. In the field of rotomoulding, Merck claims to be 'making something possible that was previously impossible', namely giving rotomolded plastic parts an attractive pearl lustre effect. Based on its classic mica Iriodin® pigment series, the company has developed innovative Iriodin RMP preparations that, it says, allow the production of hollow plastic bodies with 'brilliant colour effects', thereby paving the way for creative plastics manufacturers and designers 'to capture additional markets for innovative products'. As Merck explains, until now the rotomolding market has been dominated by standard products with a focus on function: large-sized hollow bodies such as water tanks, trash containers, rain barrels and recycling bins. According to the company, attempts to enhance rotomolded products with decorative pearl lustre effects have consistently failed: the particles did not blend with the basic polymer as desired, but were concentrated on the inside of the product or unevenly distributed and, as a result, no two parts resembled each other. However, with Iriodin RMP, Merck claims to have succeeded in processing pearl lustre pigments for rotomolding applications such that reliable results are achieved. The preparations can simply be incorporated into the polymer, without affecting the production time, it says. The particles disperse evenly and give the entire end product its 'characteristic and fascinating pearl lustre', the company reports. Four pigment preparations are being launched initially, with more expected to follow. Iriodin 119 WAY RMP (Polar White) provides a silver-white pearl lustre effect and 'excellent resistance' against weathering effects and yellowing, according to Merck. By contrast, Iriodin 6163 RMP (Icy White Shimmer) offers an even more intensive glitter effect combined with the advantages of a synthetic substrate, it comments. Iriodin 305 RMP (Solar Gold) gives plastics 'a touch of luxury', while Iriodin 504 RMP (Red) makes red stylings possible, the company says. Allowing for the first time the creation – in the rotation process – of decorative hollow bodies with impressive effects that unite form, function and attractive design, the new pigment series will facilitate rotomoulding to capture 'completely new markets', Merck believes. With Iriodin RMP, the design of flower pots or rain barrels, chairs or seat cubes, lamps, canoes, buoys and floating docks can be 'imaginative, appealing and individualized', the company claims. Merck is one of the world's leading suppliers of effect pigments for the coatings, plastics, printing, cosmetic, food and pharmaceutical industries. Such pigments are an important design element when creating surfaces with special impressions or qualities. Application possibilities range from cars to packaging, and from high-tech products to building facades, the company says. In addition to decorative effect pigments, Merck offers pigments that also have functional applications such as anti-counterfeiting or	August 2015

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heat-reflection.	

Se completó este estudio con una revisión de información técnica y aplicaciones de la tecnología de marcado láser sobre materiales plásticos y otros como madera/metal/vidrio…

CO_2 Laser Marking

CO_2 are gas lasers which are stimulated electrically. They operate at the 10,600 nm wavelength, and are mostly used for marking applications on non-metallic materials and most plastics.

The CO_2 lasers are largely used in food, drug, or alcohol packaging, integrated circuits, electrical appliances, mobile communications, and electronic components.

BENEFITS

- Ideal for marking paper, cardboard, wood, leather, glass, ceramics and plastics.
- High efficiency and good beam quality
- Very concentrated beam spot size
- Fast engraving speeds, low power requirements

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LASER MACHINES APPLICATIONS KNOWLEDGE ABOUT TROTEC CONTACT + SUPPORT

With a Trotec laser, you can quickly and easily laser cut a variety of textiles to size. Materials can be also be given a high-quality finish with a tactile effect. Whether you use it to engrave felt or to cut extravagant shapes out of polyester, lasers offer you incredible design possibilities. Synthetic substances react very well during processing, the laser beam fuses edges on polyester and prevents fraying.

Contact Us

Textile types suitable for laser processing

- Cotton
- Felt
- Silk
- Linen
- Lace
- Polyester
- Fleece
- Softshell
- Jeans
- Alcantara

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Difference between MOPA and fiber laser

More possibilities for laser marking plastics

With a fiber laser you can mark a wide range of plastics. Due to the different chemical compositions of the plastics, the result is very different. While the marking result with a conventional fiber laser is very good with some plastics, other plastics are less homogeneous or rich in contrast when marked. These plastics - especially dark plastics (e.g. PA 66 GF, PA 6 GF, PP GF, etc.) - can often be marked much lighter or more homogeneously with a MOPA laser. The advantage of the MOPA technology is the selectable pulse durations of the laser. This results in more options when choosing laser parameters. This can lead to a better marking quality, better contrasts, etc. for the plastics mentioned above.

The material is heated during laser marking. By heating the material, the color of many plastics changes (e.g. by changing color or carbonizing), resulting in a contrast and thus the marking. In conventional fiber lasers, the pulse duration is relatively long (100 ns), whereby the material burns or boils up or foams in some plastics. For these plastics (e.g. many dark plastics that turn light), the MOPA laser provides the ideal solution.

More information about MOPA laser

Electronic part lasermarked

Laser marking on dark plastic parts

Adjustable pulse durations thanks to MOPA technology

Thanks to the short pulses, which can be variably adjusted (between 4 and 200 ns) with the MOPA laser, and the low pulse energy, the surrounding material is less heated. Thereby, the material burns less and foams less. Especially on dark plastics, the shorter pulses can often produce "nicer", lighter laser markings. This results in a better contrast and thus better (machine)-readability.

These dark plastics are characterized by a high reactivity to the laser beam. Thus, short pulses with relatively little heating of the material are necessary and sufficient here. In addition, there are also plastics that require more energy to sufficiently foam or boil up the material. Here, both a conventional fiber laser with longer pulse durations and high pulse energies and the MOPA technology are suitable. With the MOPA laser, even longer pulses are possible, whereby the controlled foaming can be optimized.

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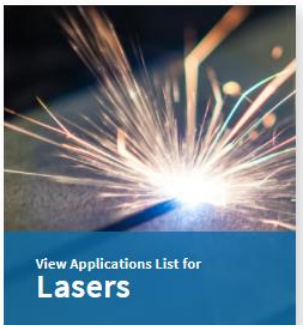

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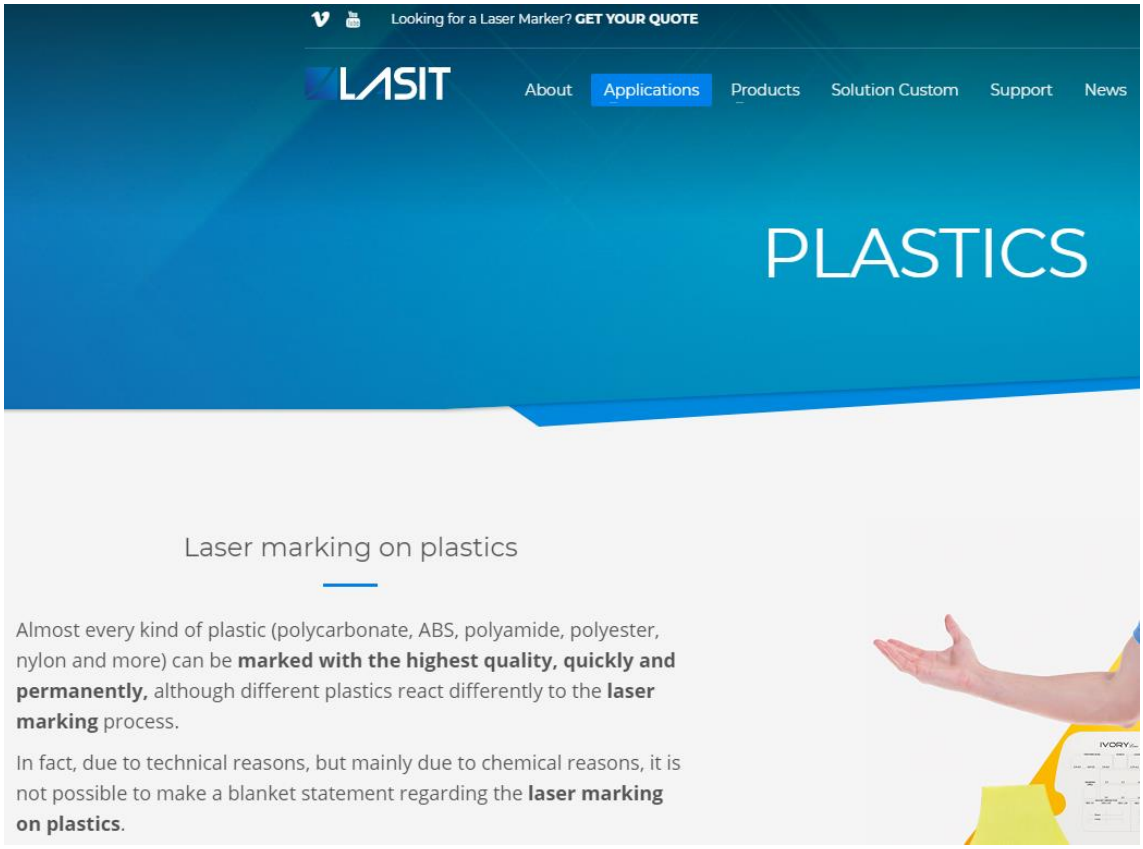

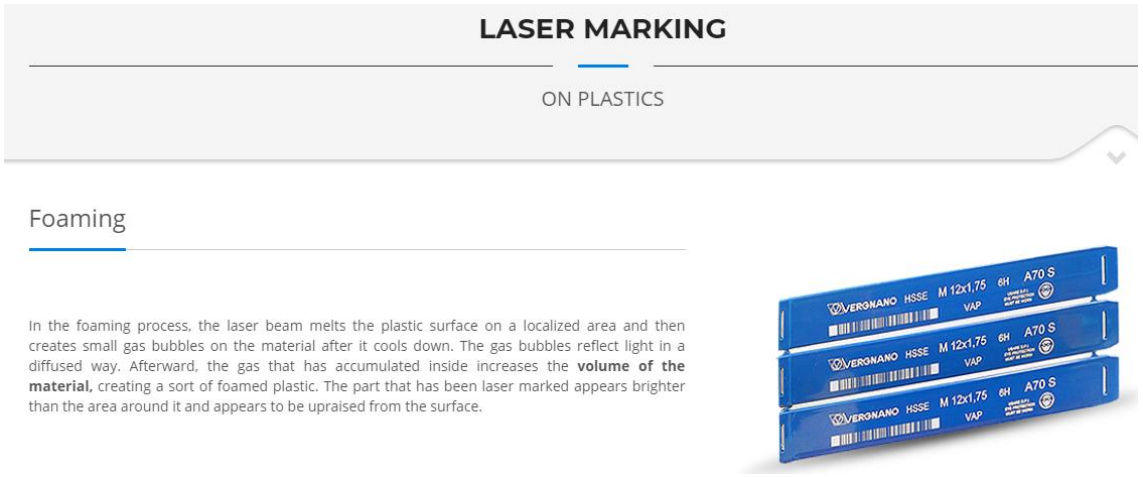

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Carbonization

Laser carbonization always produces a darkening of the material that has been marked. Plastic bonds are broken and carbon is released during this process. The resulting **discoloration** ranges from gray to bluish gray to black. Carbonization is used on clear plastics and organic materials (paper, packaging, wood and leather), with a resulting **chromatic effect** that changes from clear to dark.

Color change

Plastics absorb the light from the laser. **Color pigments** (deriving from additives, colors, etc.) and carbon in plastics are destroyed and vaporize as a result of localized heating. At this point, you will see a color change and notice foaming. The carbon in the plastic oxidizes and produces CO2, which is released from the plastic forming a layer of foam. Depending on the composition of the material, the discoloration may be clearer or darker. The dark plastics turn white where they were marked while clear plastics turn gray or black.

Research Article, J Fashion Technol Textile Eng Vol: 5 Issue: 4

Surface Textile Design of Polar Fleece Using Laser Engraving Technique

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Abstract

The purpose of this study is to develop textile surface design of polar fleece by using laser engraving technique. A prototype of textile design was proposed by combining selected textile design elements before making the textile design samples. The program, 4D-PLANS, was used to express the raised material and Adobe Photoshop CS6, Adobe Illustrator CS6 were used to make patterns with a dot motif. Adobe Photoshop CS6 was used for the final textile design prototypes. Its actual figures were produced by surface finishing-laser engraving. A functionality test and visual evaluation were conducted to test whether the laser engraving polar fleece is suitable as an outer textile material. As a result of the thermal test of laser-engraving polar fleece and original polar fleece, there was no significant difference in warmth when using laser engraving with less than 50% of the total area. The design evaluation indicates that the subjects are satisfied with colors, textures and patterns with over 4.0 of average on a five-point Likert-type scale. In particular, satisfaction with textile is highest. Therefore, this study will suggest diversity for the development of surface design of napping materials applying laser engraving technique.

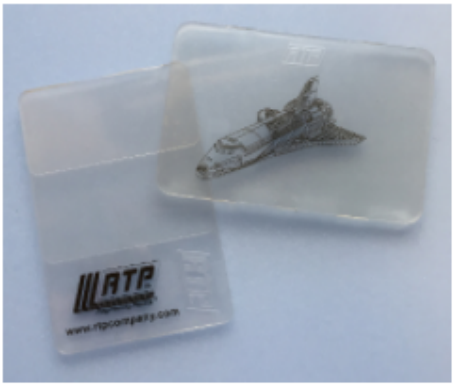
Keywords: Surface textile design; Laser engraving; Polar fleece

July 7, 2017 UPDATED 7/7/2017

Laser-marking and new colors fill RTP line-up

By FRANK ESPOSITO

Materials Medical



RTP Co.

RTP Co.'s laser-markable compounds has expanded to include a wider range of colors.

New York — Materials maker RTP Co. is finding success with laser-markable compounds and has unveiled a new color lineup as well.

"Laser-marking systems like [Unique Device Identification] are gaining more traction and more interest because of FDA requirements," strategic account manager Joe Hennessey said at the UBM Advanced Manufacturing Expo, June 13-15 in New York. "We can help OEMs get their markings on individual medical devices."

Laser-marked applications include injection pens for dosing. Winona, Minn.-based RTP offers a wide range of laser-markable materials in several resins, including PEEK. The technology can overcome difficulties caused by other additives such as carbon black, Hennessey added.

"Medical has a long path of product development, but it's our second-largest market and it's growing at double-digit rates," he said. "We can advise a molder on which material to use. In medical, it's all about minimizing risk."

The color program is part of RTP's Hueforia color development team, which was founded in 2014 and recently updated. New colors for 2018 include Grand Canyon, Obelisk, Midas Touch and Tahitian Blue.

"We've had success in engineering and design markets," sales engineer Brian Lynch said. "Designers want to change colors and see new colors.

"They're always looking for inspiration in everything from the Oscars to the Olympics," he added. "So we want to give them a range they can use for consumer products or other markets."

RTP ranks as one of North America's 30 largest compounders and concentrate makers. The firm operates 17 plants worldwide, making compounds based on 60 different engineering resins.

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Guardian sustainable business
Packaging

Swedish supermarkets replace sticky labels with laser marking

Food retailers aiming to cut plastic packaging by ditching stickers on fruits and vegetables, instead using hi-tech 'natural branding'

Trials of plastic-free laser labels have begun with sweet potatoes and avocados. Photograph: ICA/Nature & More

Nina Pullman
Nina Pullman is deputy editor at the Fresh Produce Journal

Mon 16 Jan '17 05.00 GMT

This article is 12 months old

91,826 127

The humble fruit sticker may seem an unlikely cause for environmental concern but removing it from produce could create huge savings in plastic, energy and CO_2 emissions.

In response to consumer demand for less packaging, Dutch fruit and veg supplier Nature & More and Swedish supermarket ICA have joined forces to run a trial to replace sticky labels on organic avocados and sweet potatoes with a laser mark.

M&S are also using it on coconuts in the UK.

Dubbed "natural branding", the technique uses a strong light to remove pigment from the skin of produce. The mark is invisible once skin is removed and doesn't affect shelf life or eating quality.

"By using natural branding on all the organic avocados we would sell in one year we will save 200km (135 miles) of plastic 30cm wide. It's small but I think it adds up," says Peter Hagg, ICA business unit manager.

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nent we can provide you with a
est of your subject **marked**
y material you request.

UEST YOUR FREE SAMPLE

Easy and fast!

FlyCO2: the ideal solution for laser marking on woods

The **FlyCO2** is the ideal **laser engraving machine** for woodworking. Extremely compact, modular, it can be fully integrated into any production line. Comparing the other conventional solutions – such as the ink-jet printing – FlyCO2 is designed for **high productivity** while at the same time reducing operation costs.

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Can a Fiber Laser Mark Wood?

May 23, 2017 by Joshua Christley

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A lot of customers who operate a Fiber Laser for marking projects may want to make the most of their investment and try it on new materials. A common question that arises is: "Can my fiber laser mark on wood?"

The quick answer is "yes."

The correct answer is "no."

What happens when you use a Fiber Laser on Wood?

Let me explain. I said "yes" because you can technically use a fiber laser on wood. But would you want to?

Anyone that has experimented can attest that you can light wood on fire with a fiber laser. That is really all you are doing with the wood: starting a campfire.

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Fiber Laser: *Uncontrolled absorption effects from a short wavelength*

Why does wood react this way to a Fiber Laser?

The 1064nm wavelength of a fiber laser transmits partially through the organic structure based on its shorter wavelength. This is why 1064nm is used for medical procedures like laser eye surgery. This wavelength allows the laser beam to travel through skin or eye tissues to do its work non-invasively at a deeper level.

With the beam traveling into the wood, heat is building up. It is absorbed uncontrollably because of the variances in the wood material. Eventually, it will ignite and the wood is then fuel for the intense heat.

Due to the uncontrolled absorption, an uncontrolled mark is the result. If you have spent time trying to force this technique, it will produce an uneven looking mark, with some places charred and others vaguely representing anything at all.

What is the Correct Laser to Use for a Good Mark on Wood?

The CO2 laser is the correct tool for marking wood. The 10600nm wavelength is 10x larger and is easily absorbed by organic materials, which reacts with wood like a true cutting tool would.

The results are clean and controlled marks, free from charring and campfires. Our customers have used the CO2 to successfully add branding marks or traceability information to their wooden products like furniture, gun stocks, floor planks, pallets, barrels, and more.

CO2 Laser: *Even absorption from a longer wavelength*

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trotec
laser. marking cutting engraving

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LASER MACHINES APPLICATIONS KNOWLEDGE ABOUT TROTEC CONTACT + SUPPORT

Published on: 07/24/2017

- Chipboard
- Cork
- HDF/MDF
- Multiplex
- Natural wood/ real wood
- Plywood
- Precious woods
- Solid wood, solid timber (eg meple wood, teak wood)
- Veneers

There are many advantages to incorporating a laser machine into your work flow. The most significant of these being precision; Trotec lasers can cut within a tenth of a millimetre in precision. Additionally, the non-contact processing saves time and lets your process the thinnest wood materials.

Laser machines are great at cutting out fine, articulate shapes that would either be very difficult or in some cases impossible to cut by conventional means.

In addition to cutting, laser machines also offer the option of marking or etching on the wood surface, which opens potential in customisation or introducing a textured effect in your wood creation, creating a desirable contrast on the one piece of wood.

Tips for laser cutting wood and laser engraving wood

Will the laser always produce a dark mark on woods?

Yes. Wood lasering is a sublimation process, meaning the solid material is converted directly into a gaseous state through combustion. In the case of wood, this can leave a dark burn colour around the edge of the cut or a deep mark. However, this is not bad, and very often actually desirable. You can reduce the dark mark by accurately focusing the laser and selecting the appropriate parameters. Optimum optics and good supply of compressed airflow will also assist with achieving a high quality cut and engraving result.

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CO2 laser engraving is the best method to deeply etch into a wide array of timber products and composites such as hardwood, pine, plywood, veneers, OSB, MDF, bamboo and balsa.

Laser engraving provides a vivid and crisp white contrast on clear and colour tints, or achieve deep contrast by laser engraving and paint filling with a rainbow of available colours.

Perfect for interior applications such as wayfinding signs, name badges, plaques and awards or for industrial applications such as nameplates, labels and tags.

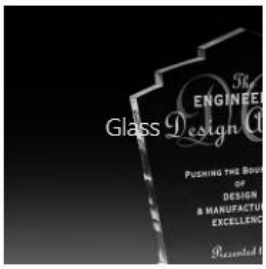
Specified for exterior applications, this 2 layer engraving laminate has UV and weather resistance, suitable for military and marine environments.

Using the intense focal precision of CO2 lasers, fluid ceramic can be heat annealed directly onto stainless steel providing a permanent black mark.

Black contrast engraving can be achieved with heat annealing ceramic paste with the high resolution and heat of our CO2 Laser Engraving systems.

Highly durable with precision accuracy, our CO2 lasers can engrave engineered parts or our stock anodised aluminium sheet that comes in many colours.

When you need logos, artwork or industrial identification on powder coated or painted metals, CO2 laser engraving is your perfect choice for clarity and consistency.



Providing a frosted white contrast on glass items, CO2 laser engraving is an inexpensive way to brand and individualise for hospitality, promotions and weddings.

CO2 laser engraving can make your mark as permanent as you can imagine, by having it 'written in stone' or granite, marble, slate, basalt, pebbles, tiles, ceramic or porcelain.

Soft fabrics such as cotton, denim, felt, fleece, polyester, neoprene, linen or lace can be pattern cut or laser engraved for exciting tactile branding possibilities.

We can individually engrave wallets, bracelets, belts or cut and engrave suede, natural and synthetic leathers or even raw hide to your designer shape with a unique quality and depth.

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3. TECNOLOGÍA DE OZONO

En la industria textil, el ozono se utiliza tanto para tratar y procesar tejidos como en el tratamiento de aguas residuales (en este caso para desinfección/deodorización, principalmente). Puesto que el O3 es un gas altamente oxidante, tiene capacidad de limpiar, desinfectar e incluso aportar efectos de bleaching (blanqueo) sobre los textiles, principalmente fibras naturales.

En su uso habitual y masivo como tecnología de acabado para denim, el ozono se aplica sobre las prendas denim algo húmedas -ya que la humedad promueve la transferencia del O3 al interior de la fibra-, de manera que los radicales O· del ozono atacan sobre todo las moléculas de colorante con que está tintada la fibra; también atacan, aunque en menor medida, otros químicos presentes como aceites de ensimaje y diversas manchas principalmente de origen orgánico. Con ello, pueden obtenerse tanto efectos de limpieza y de bleaching similar al que aportaría el proceso tradicional con peróxido de hidrógeno, así como decoloración controlada de las prendas denim buscando efectos de moda/diseño. También elimina en gran parte el backstaining (sobretintura, redeposición de índigo) del reverso de los bolsillos de los jeans.

Rango de efecto de bleaching (blanqueo) obtenido sobre denim mediante ozono (Fuente: Ozone Finishing for Denim Reduces Environmental Impact, Processing Costs and Processing Time. Apparel, Enero 2014).

Las fibras textiles tratadas con ozono apenas sufren degradación mecánica (M Prabaharan et al. J.S.D.C., 116 (2000) 83), de manera que se obtienen ventajas de proceso y medioambientales ya que los agentes reductores -álcalis- y otros (fosfonatos, ácidos policarboxílicos, etc.) empleados cuando se utiliza peróxido de hidrógeno por la vía tradicional, en el caso del O3 se eliminan del proceso así como varias etapas de lavado necesarias para la eliminación tanto del color sobrante como de los aceites y moléculas orgánicas que provocan manchas. Además, se reduce drásticamente la cantidad de agua consumida, ya que si bien la tecnología de ozono no elimina su uso total -al introducirse los textiles algo húmedos- si disminuye significativamente su consumo, así como el de energía y químicos.

Es una tecnología ya madura de tratamiento de textiles, especialmente en dénim, y algunos ejemplos de proveedores de estos equipos y de fabricantes de instalaciones y generadores de ozono para uso en textil y afines son:

- JEANOLOGIA.
- TONELLO.
- ROKA TEXTILE.

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- TUPESA.
- AIRCARE TECHNOLOGY LTD.
- HITECH ENGINEERED SOLUTIONS.
- VAV TECHNOLOGY.
- ACG PULSE.

A lo largo del trabajo de investigación en PT1 se identificaron y analizaron diferentes documentos relacionados con la aplicabilidad que puede tener el tratamento con ozono de materiales textiles y poliméricos, no solo para obtener efectos de blanqueo y decoloración, sino también con fines higienizantes, de limpieza de textiles, etc. Los documentos y ejemplos más relevantes investigados fueron:

Nº PUBLICACIÓN	TÍTULO Y RESUMEN	FECHA PUBLICAC.
OZONE PROCESS FOR COLOR REMOVAL		
US20170016175	Embodiments relate generally to methods and systems for bleaching textiles using ozone gas that incorporates a color removal step. In one example, there is provided a hybrid machine that incorporates certain features of a washer, but that also includes an integrated blower for gas distribution inside the machine. There is also provided an ozone dosing control system that allows for maintenance of a constant concentration of ozone in the machine. In one embodiment, the ozone output measured in grams/hour at this constant concentration in conjunction with the weight of product measured being treated may be referred to as the "bleaching factor." There is further provided a wastewater dye removal step, in which ozone is used to clean the water and remove dyes and other colors that may be deposited via denim or other garments.	01/19/2017
COLOR REMOVAL OF WATER WITH OZONE IN A TEXTILE BLEACHING PROCESS		
US2016/054680	Embodiments relate generally to methods and systems for bleaching textiles using ozone gas that incorporates a color removal step. In one example, there is provided a hybrid machine that incorporates certain features of a washer, but that also includes an integrated blower for gas distribution inside the machine. There is also provided an ozone dosing control system that allows for maintenance of a constant concentration of ozone in the machine. In one embodiment, the ozone output measured in grams/hour at this constant concentration in conjunction with the weight of product measured being treated may be referred to as the "bleaching factor." There is further provided a wastewater dye removal step, in which ozone is used to clean the water and remove dyes and other colors that may be deposited via denim or other garments.	04/20/2017
OZONE PROCESS FOR COLOR REMOVAL		
US20170016175A1	Embodiments relate generally to methods and systems for bleaching textiles using ozone gas that incorporates a color removal step. In one example, there is provided a hybrid machine that incorporates certain features of a washer, but that also includes an integrated blower for gas distribution inside the machine. There is also provided an ozone dosing control system that allows for maintenance of a constant concentration of ozone in the machine. In one embodiment, the ozone output measured in grams/hour at this constant concentration in	01/19/2017

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	conjunction with the weight of product measured being treated may be referred to as the "bleaching factor." There is further provided a wastewater dye removal step, in which ozone is used to clean the water and remove dyes and other colors that may be deposited via denim or other garments.	
LAUNDRY SYSTEM FOR SMART GARMENTS		
WO2016/079139	Laundry apparatus (100) and methods for cleaning garments are provided, whereby the laundry apparatus (100) can provide one or more of: ultraviolet light, ultrasound, ozone, carbon dioxide, and a surfactant source to clean the garments and includes an electronic control system (130) configured to transmit data corresponding to the laundry apparatus cleaning conditions and cleanliness of the garments wirelessly to an external computing device (132).	05/26/2016
METHOD OF TREATING FABRICS AND GARMENTS		
WO2012/119532	A method of treating pairs of denim jeans is disclosed as carrying out the following steps in the following order: (a) forming patterns on the jeans by topical abrasion; (b) rinsing the jeans with water; (c) subjecting the jeans to ozone treatment; and (d) rinsing the jeans with water, in which no chemical (other than ozone and water) is used in any of these steps.	09/13/2012
Método y dispositivo para lograr una protección de desinfección higiénica durante un proceso de limpieza o lavado		
DE102015014469A	Es un método y proporcionado para este aparato para lograr una protección desinfección higiénica en un proceso de limpieza o lavado comercial en un dispositivo en forma de una máquina textil o cuero-limpieza, una lavadora-centrífuga, una sección de lavado, un plato y / o gafas de arandela y / o un dispositivo en el privado o semi-profesional descrito en la forma de una lavadora doméstica, una máquina combinada lavadora-secadora, un lavavajillas o un lavavajillas, en el que capaz de ser utilizado durante el proceso de limpieza o lavado un medio de limpieza o lavado , en donde para lograr la protección desinfectante higiénica del orden de al menos 10^{-5} o 10^{-6}el medio de limpieza o lavado está enriquecido con ozono .	05/11/2017

TÍTULO Y RESUMEN (ARTÍCULOS)	**FECHA PUBLICAC.**
Antimicrobial activity of ozone. Effectiveness against the main wine spoilage microorganisms and evaluation of impact on simple phenols in wine	
Background and Aims Microbial contamination affects winemaking, especially after fermentation, e.g. wine ageing in barrels or in contact with oak pieces, when spoilage microbes find an environment favourable for their development. Ozone was evaluated as a sanitising agent in order to assess its potential to prevent microbial spoilage occurring during ageing of wine in barrels using a model system based on barrel wood. **Methods and Results** Fifty microorganisms of oenological significance were evaluated for their spoilage potential in the barrel. Ethanol resistance, biofilm formation and production of volatile phenols were studied using physiological tests. The effectiveness of ozone in eliminating microorganisms was evaluated in aqueous solution at several cell and ozone concentrations. At a high cell concentration, the presence of organic matter reduced the effectiveness of ozone. At a cell concentration of under 10^3 CFU/mL, typical of wine cellars, ozone was able to eliminate microorganisms. Resistance to ozone was observed in diverse microorganisms, and this feature is linked to their ability to produce a biofilm. The reduction in simple phenols obtained from oak wood was tested by treating oak chips, routinely used in the wine industry, with an increasing dose of ozone. There was no statistical difference in the phenolic composition of wine treated with six commercial chips. Only a significant exposure of the chips to ozone caused a 33% reduction in the initial content of gentisic acid. **Conclusions** Ozone was shown to be a highly effective sanitising agent without interfering with the profile of the phenolic	03/27/2013

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substances extracted from oak. The application of ozone for barrel sanitising may be a feasible solution for the prevention of wine spoilage during ageing in oak barrels. **Significance of the Study** A survey of the effect of ozone on a large number of microorganisms and phenolic compounds of oenological significance, considering some technological variables, is reported.	
Degradation of reactive dyes in wastewater from the textile industry by ozone: Analysis of the products by accurate masses	
The present work describes the use of ozone to degrade selected reactive dyes from the textile industry and the analysis of the resulting complex mixture by liquid chromatography/mass spectrometry (LC–MS). To allow certain identification of the substances detected in the wastewater, the original dyes were also investigated either separately or in a synthetic mixture of three dyes (trichromie). Since the reactive dyes are hydrolyzed during the dyeing process, procedures for the hydrolysis were worked out first for the individual dyes. The ozonated solutions were concentrated by solid-phase extraction, which separated very polar or ionic substances from moderately polar degradation products. The latter, which are the primary degradation products, were investigated by liquid chromatography/mass spectrometry with a tandem quadrupole time-of-flight mass analyzer. Accurate masses, which in most cases could be determined with a deviation of ≤5 ppm from the exact value, were also measured. In addition, a diode-array detector was placed before the mass analyzer to provide UV–vis spectra of the products in the same run. With retention times, mass spectra, accurate masses, UV–vis spectra and, of course, knowledge of the structures of the original dyes, plausible structures could be proposed for most of the components of the moderately polar fraction. These structures were confirmed by ^{1}H NMR in cases where it was practical to isolate the by-products by preparative HPLC.	February 2009
The enhanced cationic dyeability of ultraviolet/ozone-treated meta-aramid fabrics	
Aramid fabrics were photo-oxidised by ultraviolet/ozone irradiation. The surface properties of the modified fabrics were characterised by reflectance, attenuated total reflectance, electron spectroscopy for chemical analysis and surface zeta potential. The ultraviolet irradiation caused the oxygen content of the aramid fabric surface to increase, with the appearance of carbonyl and hydroxyl groups, and reduced the surface zeta potential, coupled with improved water wettability. Moreover, the crystalline structure did not change after ultraviolet/ozone treatment according to X-ray diffraction results. The modified aramid fabrics showed higher affinity to cationic dyes, which may have resulted from the newly introduced electrostatic interaction between cationic dyes and anionic dyeing sites on the photo-oxidised surface layers. Although colour fastness to both staining and rubbing were good to excellent, colour fastness to shade change was moderate. Furthermore, the ultraviolet/ozone pretreatment and cationic dyeing of aramid fabrics may overcome the loss in the mechanical properties associated with previously recommended dyeing methods for aramid fabrics.	05/09/2011
Ozone bleaching of cotton fabrics with the aid of ultrasonic humidifier	
Cotton is an important industrial commodity for textile production. Its finishing is complicated and requires energy, chemicals and water. In this respect, for its sustainable production, some precautions should be taken. Today, due to consumer's awareness of environmental issues, studies on ecologic alternative finishing processes have attracted much attention. In this study cotton, which is a natural cellulosic fiber, was bleached via the use of ozone gas and ultrasonic humidifier. Then the coloration of the fabrics was conducted by using green walnut shells (husks). In this way, it was planned to introduce alternative sustainable methods for cotton fabric finishing. It was found that ozone can be used for bleaching of cotton fabrics and even when no mordanting was applied; good colors with sufficient fastnesses were obtained from the cotton fabrics dyed with green walnut shells (husks). Moreover a way to utilize green walnut shells (husks), which are in fact cellulosic waste, was also introduced.	August 2016

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— *ohne internationalen Recherchenbericht und erneut zu veröffentlichen nach Erhalt des Berichts (Regel 48 Absatz 2 Buchstabe g)*

4/198744 A2

(54) Title: METHOD FOR FINISHING DENIM

(54) Bezeichnung : VERFAHREN ZUR VEREDELUNG VON JEANSSTOFFEN

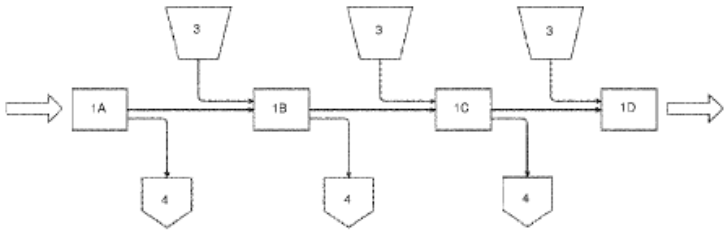

Fig. 1

(57) Abstract: The invention relates to a method for finishing a first type of denim, in which the first type of denim is treated at least once in an aqueous solution containing additional substances, during the treatment, the coloured aqueous solution is removed and a non-coloured aqueous solution is added. According to the invention, at least one part of the coloured aqueous solution is subjected to a decolouring process and the coloured aqueous solution is used in the treatment.

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US 20120276821A1

(19) **United States**

(12) **Patent Application Publication**

RICHARDIERE et al.

(10) **Pub. No.: US 2012/0276821 A1**

(43) **Pub. Date: Nov. 1, 2012**

(54) **METHOD AND SYSTEM ENABLING PREMATURE USE OF A TEXTILE GARMENT MADE OF DENIM FABRIC**

(76) Inventors: **Gilbert RICHARDIERE**, Marseille (FR); **Lylian Richardiere**, Marseille (FR)

(21) Appl. No.: **13/096,806**

(22) Filed: **Apr. 28, 2011**

Publication Classification

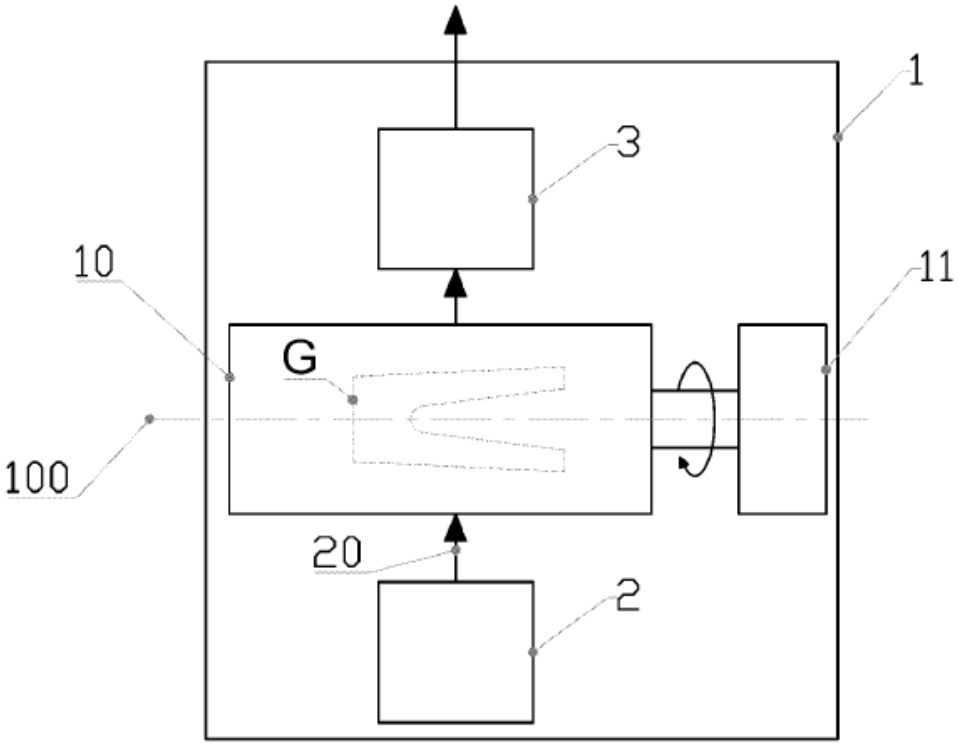
(51) **Int. Cl.**

D06L 3/14	(2006.01)
B24B 1/00	(2006.01)
D06L 3/04	(2006.01)

(52) **U.S. Cl.** **451/54**; 8/111; 68/139

(57) **ABSTRACT**

The invention relates to a method of premature wear of a fabric garment made of a colored denim canvas, wherein the aforementioned garment is placed into a rotating machine including a drum, characterized by the fact that the aforementioned method comprises a step during which the garment is rotated in the drum without being wetted or dampened, ozone gas being injected simultaneously into the interior of the aforementioned drum so as to bleach the aforementioned garment and give it a wear effect.



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Ozone: Science & Engineering
The Journal of the International Ozone Association

Ozonation as an Environmentally Friendly Method to Decolorize the Leather Products

Ersin Onem, Ali Yorgancioglu, Gamze Namirti, Seher Perincek, Bahri Basaran & Kerim Duran

Received 30 Nov 2016, Accepted 19 Apr 2017, Accepted author version posted online: 27 Apr 2017

http://dx.doi.org/10.1080/01919512.2017.1322487

Abstract

In this study, ozonation as an environmentally friendly bleaching method was studied for decolorization of leather products. The effect of ozonation time (3, 5, 10, 15 and 30 min) and water pick up value (WPV) (0%, 20%, 40%, 60%, 80% and 100%) were investigated on decolorization effect. For this aim, the color measurement and tensile strength tests were performed, and also structural changes were determined by Scanning Electron Microscope (SEM) and Fourier Transform Infrared spectroscopy (FTIR) after ozonation process. The results of color measurements showed that 30 min for ozonation and 60% WPV were optimum parameters to obtain maximum decolorization effect. SEM images of the ozonated leathers showed some deformations on the collagen fibers and resulted with the slightly decreases in tensile strength of the products. On the other hand, decreases in the tensile strength values were not statistically important levels.

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J. Braz. Chem. Soc., Vol. 12, No. 3, 273-324, 2001.
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Review

The Chemistry of Isatins: a Review from 1975 to 1999

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Isatinas (1H-indol-2,3-diona) são compostos de grande versatilidade sintética, podendo ser utilizados na obtenção de diversos sistemas heterociclos, como derivados indólicos e quinolínicos, o que as tornam importantes matérias-primas na síntese de fármacos. Isatinas também têm sido detectadas em tecidos de mamíferos, o que tem despertado o interesse em seu estudo como moduladores em diversos processos bioquímicos. Os avanços na aplicação de isatinas em síntese orgânica, bem como na compreensão de seus efeitos biológicos e farmacológicos nos últimos vinte e cinco anos encontram-se relatados nesta revisão e seus respectivos materiais suplementares.

Isatins (1H-indole-2,3-dione) are synthetically versatile substrates, where they can be used for the synthesis of a large variety of heterocyclic compounds, such as indoles and quinolines, and as raw material for drug synthesis. Isatins have also been found in mammalian tissue and their function as a modulator of biochemical processes has been the subject of several discussions. The advances in the use of isatins for organic synthesis during the last twenty-five years, as well as a survey of its biological and pharmacological properties are reported in this review and in the accompanying supplementary information.

Keywords: isatin, heterocyclic synthesis, drug synthesis, metal complexes

1. Introduction

Isatin (1H-indole-2,3-dione, Figure 1) was first obtained by Erdman and Laurent in 1841 as a product from the oxidation of indigo by nitric and chromic acids.

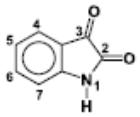

Figure 1.

The synthetic versatility of isatin has led to the extensive use of this compound in organic synthesis. Three reviews have been published regarding the chemistry of this compound: the first by Sumpter, in 1954[1], a second by Popp in 1975[2], and the third on the utility of isatin as a precursor for the synthesis of other heterocyclic compounds[3]. The synthetic versatility of isatin has stemmed from the interest in the biological and pharmacological properties of its derivatives. These properties are more fully detailed in the supplementary material.

In nature, isatin is found in plants of the genus *Isatis*[4], in *Calanthe discolor* LINDL.[5] and in *Couroupita guianensis* Aubl.[6], and has also been found as a component of the secretion from the parotid gland of *Bufo* frogs[7], and in humans as it is a metabolic derivative of adrenaline[8-10]. Substituted isatins are also found in plants, for example the melosatin alkaloids (methoxy phenylpentyl isatins) obtained from the Caribbean tumorigenic plant *Melochia tomentosa*[11-13] as well as from fungi: 6-(3'-methylbuten-2'-yl)isatin was isolated from *Streptomyces albus*[14] and 5-(3'-methylbuten-2'-yl)isatin from *Chaetomium globosum*[15]. Isatin has also been found to be a component of coal tar[16].

This review aims to document the publications concerning isatin, its synthesis, chemical reactivity and pharmacological properties during the period from 1975 to 1999. The biological and pharmacological data obtained from the scientific literature are summarized in Electronic Supplementary Information (ESI) 1. A graphical survey of the application of isatin in the synthesis of other heterocyclic systems is presented in ESI 2, and ESI 3

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Study of Parameters Affecting Dry and Wet Ozone Bleaching of Denim Fabric

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ABSTRACT

The present research is related to a recent eco-friendly technology in a denim laundry that relies on ozone oxidation of indigo. In this work, denim fabric was treated with ozone at different values of ozone concentration, moisture content and time of exposure to ozone. The fading increased with the increase of the various mentioned factors. Residual products of the indigo oxidation by ozone, the cause of the yellowing observed on the surface of the fabric were identified through spectrophotometric measurements, pH variation and FTIR analysis. Ozone effect on mechanical properties of the fabric was studied through the measurement of ultimate tensile strength.

ARTICLE HISTORY
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Accepted 18 September 2015

KEYWORDS
Ozone; Denim; Fading; Mechanical Properties; Moisture; Oxidation; Yellowing

Introduction

The present research is related to the decolorization of clothing dyed in indigo using ozone. Denim has survived the decades and even centuries; it is desired and necessary in every trend, yet denim/jeans remain the most polluting textile products of the world, not only because of its indigo dyeing but also the chemicals and the amount of water that it requires to obtain the best washes. Textile industries, conscious about levels of performance and productivity, wash out their jeans with lowest costs without regard for the consequences on the environment and on humans. The ozone fading of textile dyed fabric is a revolution in the entire textile sector. The ozone wash is based on a natural process that ensures enrichment of oxygen. It fades clothing and provides a significant gain in water and chemicals unlike the usual processes of bleaching based on pumice stone, bleach and enzymes that cause mechanical and chemical damage of the fabric, and a loss of tensile strength and a risk of tearing the article in thickness zones, critical areas (from hem) and presence of stone spots. An antiredepositing agent must be put in the bath in order to avoid redeposition of indigo after removing it from the surface of the fabric. That is not the case for ozone because it degrades the dyeing without generation of annoying or harmful waste products.

Ozone is a gas that is generally present in our atmosphere and is formed naturally by photochemical reaction with solar UV radiation (Hegglin et al. 2014). It can be generated artificially by several ways such as corona discharge. Ozone is a triatomic molecule consisting of three oxygen atoms. Ozone has a strong tendency to react with almost any organic substance. The use of ozone in water and wastewater treatment currently remains the most prevalent industrial application. Ozone is a powerful oxidant and disinfectant capable of destroying the cellular structure of viruses, parasites and bacteria (Sacco 2009). It has some advantages over other oxidants commonly used in the textile industry, particularly in chlorine. The main advantage is the lack of persistence: ozone is chemically unstable; it leaves no secondary derivative products on treated products.

Among the most common oxidizing agents used in a denim laundry, ozone remains the most efficient. In fact, this gas fades dyed textile materials by the rupture of the chromophores in dyes of synthetic or natural fibers. Because of its high oxidation potential (E = 2.07 eV), ozone can effectively break down complex aromatic rings of the dyes, resulting in decolorization. Color is removed when certain bonds are broken by the ozone, such as the bond -C = C- and heterocyclic and aromatic rings (Wasinger 1998). Indeed, indigo ozonolysis leads to the formation of isatin

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TRATAMIENTOS DE TEJIDOS DE ALGODÓN CON OZONO: ANÁLISIS DE LAS VARIABLES DE PROCESO, APROXIMACIÓN CINÉTICA, ESTUDIO DEL ENVEJECIMIENTO Y CARACTERIZACIÓN SUPERFICIAL

TESIS DOCTORAL

Doctorando: LORENZO BAUTISTA PÉREZ
Director de tesis: DR. ANTONIO NAVARRO SANTAÑES

PROGRAMA DE DOCTORAT DE POLÍMERS I BIOPOLÍMERS
DEPARTAMENT D'ENGINYERIA QUÍMICA
UNIVERSITAT POLITÈCNICA DE CATALUNYA

30 de Julio de 2012

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4. TECNOLOGÍA DE MICRONIZACIÓN / NANOBURBUJAS

La tecnología de micronización de fluidos -o de generación de nanoburbujas- es relativamente reciente, encontrando aplicaciones hasta ahora en el tratamiento de aguas, la industria alimentaria o la medicina.

Las bases de esta tecnología se asientan en 3 conceptos principales:

- Ionización del agua. Al ionizar el agua empleada en el tratamiento, esta diluye mejor los químicos a aplicar (en el caso de FUN2GARMENT, diversos productos funcionales de acabado y colorantes para tintura).
- Generación del micronizado. Deben generarse burbujas de aire de un diámetro menor a 0,2 micras (200 nm) para incrementar su dilución en agua, y además que éstas no colapsen y permanezcan el tiempo necesario para su interacción con el material a tratar (p.ej. 1 mm3 de nanoburbujas tiene una superficie de contacto 10.000 veces mayor que 1mm3 de burbujas 'normales').

- Contacto con el material a tratar. Es el punto clave de la tecnología, ya que hay que inyectar el micronizado generado (aire/agua/producto químico, donde la burbuja de 200 nm es la encargada de 'transportar' el producto químico de interés) en el interior de la cámara de contacto -similar a una lavadora, para el caso de FUN2GARMENT- donde se encuentra el material a funcionalizar. Controlando el tiempo de contacto y la absorción teórica de micronizado por parte del material, se puede optimizar la eficiencia del proceso.

Teniendo en cuenta que los procesos de acabado y tintura en textiles implican el uso intensivo de agua y productos químicos diversos, el potencial de esta tecnología para la aplicación de acabados y tinturas con menos consumo de agua y químicos es enorme, teniendo en cuenta además que se generará mucha menos agua residual en el proceso de acabado.

Ejemplos de fabricantes y proveedores de este tipo de tecnología para uso en textil y afines pueden ser (incluyendo fabricantes solamente del reactor/generador de nanoburbujas):

- JEANOLOGIA.
- CARE APPLICATIONS.
- DISTRI AMBIENTE.
- TONELLO (sistema similar también con ahorros de relación de baño y químicos).
- BLUE PLANET ENVIRONMENTAL.
- BIOKAVITUS.

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Tomando como base el proyecto MNB-ECOFINISHING (2013 - 2015) en el que participó AITEX, donde se validaron los potenciales ahorros en el consumo de agua (> 80%), en productos químicos (hasta el 50%), así como en la generación de aguas residuales (> 90%) en comparación con procesos tradicionales (como el dip-coating), para la funcionalización y tintura de prenda denim y convencional principalmente, en FUN2GARMENT se investiga e implementa esta tecnología de micronizado para la funcionalización y tintura de tejidos y prendas técnicas destinados a hogar y deporte, respectivamente, a partir del desarrollo de formulaciones de acabado funcional específicas y sus procesos de aplicación adaptados a los textiles objeto de la investigación.

Como en otras tecnologías involucradas en FUN2GARMENT e investigadas en este PT1, se realizó una búsqueda y análisis documental de diferentes soportes, con información relacionada con la micronización y la generación de nanoburbujas para diferentes aplicaciones.

Se muestran a continuación los resultados más relevantes, si bien cabe indicar que el volumen de información no fue tan grande como en las tecnologías láser u ozono.

Nº PUBLICACIÓN	TÍTULO Y RESUMEN	FECHA PUBLICAC.
NANOBUBBLE-AND-HYDROXYL-RADICAL GENERATOR AND SYSTEM FOR PROCESSING POLLUTED WATER WITHOUT CHEMICALS USING SAME		
KR2015/004764	The present invention relates to a nanobubble-and-hydroxyl-radical generator and, more particularly, to a system for processing polluted water without chemicals comprising: an air supply unit; an inlet pipe, connected to the air supply unit, for introducing a fluid; the nanobubble-and-hydroxyl-radical generator, comprising a pump connected to the inlet pipe, a drive motor connected to the pump, rotary blades connected to the drive shaft of the drive motor, and fixed blades connected to the inner wall of the pump and disposed between the rotary blades; and a discharge pipe, connected to the nanobubble-and-hydroxyl-radical generator, for discharging a nanobubble-generated fluid, wherein the circumferential surface of the rotary blades or the fixed blades, or both, is formed to be inclined in one direction. As such, the present invention provides a nanobubble-and-hydroxyl-radical generator capable of further enhancing a dissolution rate in such a manner that the circumferential surface of each blade is inclined to induce a disturbance phenomenon of air and a fluid, thereby accelerating micronization and mixing of air and a fluid.	10/13/2016
BUBBLE MICRONIZING NOZZLE, MICROBUBBLE GENERATOR USING THE SAME, METHOD FOR PRODUCING MICROBUBBLE-CONTAINING WATER, ARTICLE WASHING APPARATUS, ARTICLE WASHING METHOD, METHOD FOR CULTURING MARINE PRODUCT, HYDROPONIC CULTURE METHOD, AND SHOWER APPARATUS		
JP2010000260563	PROBLEM TO BE SOLVED: To provide a bubble micronizing nozzle which can effectively generate a high speed flow advantageous for bubble micronization in a high flow rate, thus can dramatically improve the micronizing effect of bubbles, and further can increase the generation amount of the bubbles in a microbubble region or a nanobubble region to a level which has not been achieved conventionally. SOLUTION: A throttle gap material 22Q having a flow guide face 22G formed on the downstream side in a flow direction at a downhill grade and a flow receiving face 22A formed so as to be raised more steeply than the flow guide face 22G to the inside face of a flow passage FP on the upstream side in a flow direction is arranged at the inside of the flow passage FP. An edge part 22E crossing the axial cross section of the flow passage FP from a first position PP toward a second position PS different from the first position PP on the inner circumferential edge in	05/24/2012

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	the axial cross section of the flow passage FP is formed at the crossing position between the flow receiving face 22A and the flow guide face 22G, and a throttle gap 21G is formed between the edge part 22E and the inside face of the flow passage FP.	
USE OF MICRO- AND NANO-BUBBLES IN LIQUID PROCESSING		
US2017/127636	Methods of reducing the viscosity of a liquid flowing through process equipment by introducing into the liquid a quantity of micro- and/or nano-sized bubbles are disclosed. In particular embodiments, the liquid comprises a plurality of very fine charged particles, such as proteins. The bubbles that are introduced into the liquid induce within the liquid/bubble interface a charge that is of the same polarity to that of the charged particles dispersed within the liquid. Liquid products comprising a plurality of micro- and/or nanobubbles are also disclosed.	07/27/2017
Fabric laundering		
US7381227B2	Relatively low levels of polysaccharides in combination with small, deformable, water-insoluble particles of a size in the range 0.05-5 microns are capable of giving benefits in a wash liquor in terms of reduced fabric abrasion.	06/03/2008

Artículos y otros documentos técnicos:

- The fundamental phenomena of nanobubbles and their behavior in wastewater treatment technologies (2016)
- What are Nanobubbles? (2013)
- Application of ozone micro-nano-bubbles to groundwater remediation (2017)
- Nucleation processes of nanobubbles at a solid/water interface (2016)
- Principle and applications of microbubble and nanobubble technology for water treatment (2011)
- Nanobubble Applications and Characterization by Nanoparticle Tracking Analysis (2016)
- Electrically controlled cloud of bulk nanobubbles in water solutions (2017)
- Newsletter CHT Bezema. Aplicación en máquinas para pulverizado (2017).

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Review Paper

The fundamental phenomena of nanobubbles and their behavior in wastewater treatment technologies

Anup Gurung, Olli Dahl & Kaj Jansson

Pages 133-142 | Received 11 Dec 2015, Accepted 10 Feb 2016, Published online: 02 Mar 2016

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Abstract

The importance of nanobubbles is widely acknowledged, particularly in terms of their role with respect to bubble size and stability. Nanobubbles are tiny spherical cap-shaped bubbles, and have several unique physical and mechanical characteristics. Longevity, virtual disappearance of buoyancy, high internal pressure, extremely large surface/volume ratio, high oxygen dissolution rate, and generation of free radicals are the important features of nanobubbles. Their peculiar characteristics have led to many applications in the various fields of science and technology, including industrial, biological, and medical fields. This paper aims to provide a state-of-the-art for nanobubble technology. The fundamentals about existence and stability of nanobubbles are reviewed. Understanding of zeta potential values in nanobubbles is reviewed. The current methods of generation and measurement of nanobubbles are reviewed. Finally, the current applications and promising potential applications of nanobubbles are discussed, such as application of nanobubbles in flotation technology, applications of nanobubbles as cleaning agents and applications of nanobubbles in degradation of organic pollutants. In spite of its fantastic properties, use of nanobubble technology is limited to medical applications. Therefore, the recent developments in nanobubble technology are fascinating and promising but challenging as well.

Keywords: Bubble, bioengineering, microbubble, nanobubble, particle, wastewater

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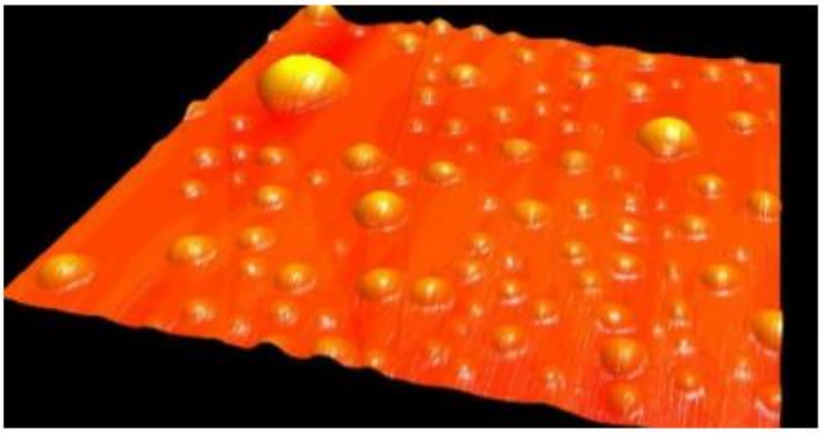

Nanobubbles at the interface between hydrophobic silica and water. Image credit: Virginia Tech

Properties of Nanobubbles

The small size of nanobubbles gives them much more interesting properties than larger bubbles, due to their high specific area and high stagnation features in the liquid phase. Free-radical generation occurs when micro- and nano-sized bubbles collapse due to the high density of ions at the gas-liquid interface that develops prior to the collapse.

It has been shown that nano-bubbles cannot remain in a stable state under atmospheric pressure due to extremely high internal pressure. Following a number of experiments, it has been suggested that the typical lifespan for a gas bubble with 100nm radius would be around 100 µs.

In saturated liquids, these nano-bubbles are extremely stable due to the absorption of ions on their surface. The gas molecules inside the nanobubbles do not come in contact with the bulk liquid, allowing the nanobubbles to last for a much longer time. Larger bubbles have air that is above atmospheric pressure, but nanobubbles contain internal pressures of tens or even hundreds of atmospheres. Under such high pressures, it has been proven that the liquid absorbs the gas inside the nanobubbles.

Applications of Nanobubbles

Some of the applications of nanobubbles which have been explored to date are listed below:

- Acceleration of metabolism in vegetables and shellfishes
- Microfluidics
- Water treatment by flotation - their high specific area makes them useful in this field
- Contrast agents for ultrasonography
- Sterilization using ozone gas
- Foam products in the food industry and other products requiring bubble stability.
- Nutritional supplement carrier in the food industry

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Journal of Hazardous Materials

journal homepage: www.elsevier.com/locate/jhazmat

Application of ozone micro-nano-bubbles to groundwater remediation

Liming Hu*, Zhiran Xia

State Key Laboratory of Hydro-Science and Engineering, Department of Hydraulic Engineering, Tsinghua University, Beijing 100084, China

HIGHLIGHTS

- This paper presents the high efficiency of gas supply and mass transfer in water using MNBs.
- The ozone MNBs technique was applied for in situ groundwater remediation of an organics-contaminated site.
- Ozone MNBs show considerable advantages in contaminant cleanup and time efficiency.
- Ozone MNBs potentially represent an innovative technology for in situ remediation of organics-contaminated groundwater.

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Mass transfer
Field test

ABSTRACT

Ozone is widely used for water treatment because of its strong oxidation ability. However, the efficiency of ozone in groundwater remediation is limited because of its relatively low solubility and rapid decomposition in the aqueous phase. Methods for increasing the stability of ozone within the subsurface are drawing increasing attention. Micro-nano-bubbles (MNBs), with diameters ranging from tens of nanometres to tens of micrometres, present rapid mass transfer rates, persist for a relatively long time in water, and transport with groundwater flow, which significantly improve gas concentration and provide a continuous gas supply. Therefore, MNBs show a considerable potential for application in groundwater remediation. In this study, the characteristics of ozone MNBs were examined, including their size distribution, bubble quantity, and zeta potential. The mass transfer rate of ozone MNBs was experimentally investigated. Ozone MNBs were then used to treat organics-contaminated water, and they showed remarkable cleanup efficiency. Column tests were also conducted to study the efficiency of ozone MNBs for organics-contaminated groundwater remediation. Based on the laboratory tests, field monitoring was conducted on a trichloroethylene (TCE)-contaminated site. The results showed that ozone MNBs can greatly improve remediation efficiency and represent an innovative technology for in situ remediation of organics-contaminated groundwater.

1. Introduction

Soil and groundwater contamination are major environmental problems; thus, numerous technologies have been developed to remediate such contaminants [1]. In situ chemical oxidation is one method commonly used to remediate polluted sites. Oxidants such as Fenton's reagent, peroxydisulfate, and permanganate show remarkable efficiency in the oxidation of organic contaminants and are generally used for site remediation [2]. However, the efficiency of the Fenton process is strongly dependent on the pH [3]. A considerable amount of oxygen is formed during the Fenton process, which may cause the blockage of pore channels and can limit the area affected by Fenton's reagent [2]. Peroxydisulfate tends to be relatively stable at ambient temperatures (~20 °C) and must be activated to be used in site remediation [4]. A large amount of sulfate is produced as a by-product [5], however, which results in secondary contamination. In situ chemical oxidation with permanganate produces MnO_2, which also may result in pore plugging and can lower the remediation efficiency [6].

Ozone is widely used for oxidation of pharmaceuticals in drinking water [7,8]. Because of its strong oxidation ability, ozone also has high potential in the treatment of wastewater [9,10]. Hydrogen peroxide can be used to accelerate the oxidation of contaminants by ozone [11,12]. However, the efficiency of ozone oxidation is limited by the rapid decomposition rate of dissolved ozone in water, which is much faster than that in the gas phase. Methods used to prolong

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SCIENTIFIC REPORTS

OPEN

Nucleation processes of nanobubbles at a solid/water interface

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Chung-Kai Fang, Hsien-Chen Ko, Chih-Wen Yang, Yi-Hsien Lu & Ing-Shouh Hwang

Experimental investigations of hydrophobic/water interfaces often return controversial results, possibly due to the unknown role of gas accumulation at the interfaces. Here, during advanced atomic force microscopy of the initial evolution of gas-containing structures at a highly ordered pyrolytic graphite/water interface, a fluid phase first appeared as a circular wetting layer ~0.3 nm in thickness and was later transformed into a cap-shaped nanostructure (an interfacial nanobubble). Two-dimensional ordered domains were nucleated and grew over time outside or at the perimeter of the fluid regions, eventually confining growth of the fluid regions to the vertical direction. We determined that interfacial nanobubbles and fluid layers have very similar mechanical properties, suggesting low interfacial tension with water and a liquid-like nature, explaining their high stability and their roles in boundary slip and bubble nucleation. These ordered domains may be the interfacial hydrophilic gas hydrates and/or the long-sought chemical surface heterogeneities responsible for contact line pinning and contact angle hysteresis. The gradual nucleation and growth of hydrophilic ordered domains renders the original homogeneous hydrophobic/water interface more heterogeneous over time, which would have great consequence for interfacial properties that affect diverse phenomena, including interactions in water, chemical reactions, and the self-assembly and function of biological molecules.

Gases dissolved in water tend to accumulate at the interfaces between hydrophobic solids and water to form cap-shaped structures that are nanometers in height; these structures are known as interfacial nanobubbles (INBs) or surface nanobubbles[1–10]. INBs have attracted much attention because of their potential implications for various interfacial phenomena and technical applications, such as long-range attractive forces between hydrophobic surfaces in solutions[11], liquid slippage at hydrophobic walls[12–14], the stability of colloidal systems[15], and bio-molecular adsorption[16]. INBs are also proposed to be the gas micronuclei that are responsible for bubble formation at solid/water interfaces[17]. However, the nature of INBs remains unknown, and the mechanisms responsible for the above phenomena are not clear.

To date, most studies have focused on why INBs exhibit high stability and why they adopt a rather flat morphology. The lifetime of an INB should be much less than 1 ms based on classical diffusion theory[18,19], but experimental observations have indicated that INBs can persist for days, which is at least 10 orders of magnitude longer than the theoretical prediction[5,6]. Although several models have been proposed to explain this unexpected stability, no consensus has been reached. A very recent model was based on the pinning of the three-phase INB-water-surface contact line[20,21], which was attributed to omnipresent chemical and geometrical surface heterogeneities[21] of unknown origin. Such surface heterogeneities were also suggested to lead to contact angle hysteresis, the difference between an advancing and a receding contact angle, for water droplets on solid surfaces[22–24].

Another fundamental but rarely addressed issue is the mechanism by which INBs nucleate at hydrophobic/water interfaces. Here, we used advanced atomic force microscopy (AFM) to investigate the initial formation of gas-containing structures at the interface between water and a mildly hydrophobic solid, highly ordered pyrolytic graphite (HOPG). Our observations, which were conducted in the frequency-modulation (FM) and PeakForce (PF) modes, provide important insights into the behaviours of dissolved gases in water and at hydrophobic/water interfaces, including formation of INBs, their nature, their high stability, the pinning of the three-phase contact lines, boundary slip, and bubble nucleation. This new understanding highlights new directions for further quantitative investigation of these behaviours under various conditions and at various interfaces, which will allow

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ELSEVIER

Chemosphere

Volume 84, Issue 9, August 2011, Pages 1175-1180

Review

Principle and applications of microbubble and nanobubble technology for water treatment

Ashutosh Agarwal, Wun Jern Ng, Yu Liu

https://doi.org/10.1016/j.chemosphere.2011.05.054

Abstract

In recent years, microbubble and nanobubble technologies have drawn great attention due to their wide applications in many fields of science and technology, such as water treatment, biomedical engineering, and nanomaterials. In this paper, we discuss the physics, methods of generation of microbubbles (MBs) and nanobubbles (NBs), while production of free radicals from MBs and NBs are reviewed with the focuses on degradation of toxic compounds, water disinfection, and cleaning/defouling of solid surfaces including membrane. Due to their ability to produce free radicals, it can be expected that the future prospects of MBs and NBs will be immense and yet more to be explored.

Highlights

► We review the potential application of micro and nanobubbles for water treatment. ► The physics and generation methods of micro and nanobubbles are discussed. ► The production of free radicals by the collapse of microbubbles is reviewed. ► Micro and nanobubbles for water disinfection, degradation of organic compounds and defouling are highlighted. ► Micro and nanobubbles technology appears to be a cost-effective and environmentally friendly approach for water treatment.

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Nanobubble Applications and Characterization by Nanoparticle Tracking Analysis

Review of ultra-fine bubble (nanobubble) applications and characterization examples

PARTICLE CONCENTRATION

PARTICLE SIZE

Introduction

The generation, measurement, and applied technologies of so-called nanobubbles or ultra-fine bubbles, with diameter ranging from tens to hundreds of nanometers, are evolving dramatically in recent years. The unique properties of nanobubbles makes them attractive for a number of applications such as facility cleaning, food disinfection, and water treatment, as well as possibilities in fields such as disinfecting food products, pharmaceutical delivery, decontamination, and manufacturing of functional materials. Preliminary market research conducted by the Fine Bubble Industries Association shows the size of the fine bubble business increasing from USD 20 million in 2010 to USD 4.3 billion in 2020.

The Nanoparticle Tracking Analysis (NTA) technique is particularly adept at the detection and analysis (size, size distribution, number concentration) of these relatively low concentration structures of extremely small size (compared to 'conventional' bubbles). NTA offers a unique capability to characterize nanobubbles by directly visualizing nanoscale particles in suspension (10 nm to 2000 nm) with high-resolution, in real-time, and with minimal sample preparation. The NanoSight models from Malvern Instruments pioneered this technique and continue to be the industry's primary choice.

The existence of surface nanobubbles is becoming fairly well established following investigation from a number of groups. Following earlier skepticism about their actual existence, confirmation of bulk nanobubbles in solution and their characterization has more recently seen more publications.

Kaneo Chiba and Masayoshi Takahashi have shown that in the presence of electrolytes and with the correct physical stimulus, stable nanobubbles can be formed from conventional microbubbles [1]. The latter tend to coalesce to large buoyant bubbles which either float away or collapse under intense surface tension-derived pressure to the point that they vanish, as predicted by theory.

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PLOS ONE

RESEARCH ARTICLE

Electrically controlled cloud of bulk nanobubbles in water solutions

Alexander V. Postnikov[1], Ilia V. Uvarov[1], Mikhail V. Lokhanin[2], Vitaly B. Svetovoy[1,3]*

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Competing interests: The authors have declared that no competing interests exist.

Abstract

Using different experimental techniques we visualize a cloud of gas in water that is produced electrochemically by the alternating polarity process. Liquid enriched with gas does not contain bubbles strongly scattering visible light but its refractive index changes significantly near the electrodes. The change of the refractive index is a collective effect of bulk nanobubbles with a diameter smaller than 200 nm. Any alternative explanation fails to explain the magnitude of the effect. Spatial structure of the cloud is investigated with the optical lever method. Its dynamics is visualised observing optical distortion of the electrode images or using differential interference contrast method. The cloud covers concentric electrodes, in a steady state it is roughly hemispherical with a size two times larger than the size of the electrode structure. When the electrical pulses are switched off the cloud disappears in less than one second. The total concentration of gases can reach very high value estimated as 3.5×10^{20} cm^{-3} that corresponds to an effective supersaturation of 500 and 150 for hydrogen and oxygen, respectively.

Introduction

Nanobubbles (NBs) are nanoscopic gaseous domains than can exist on solid surfaces or in the bulk of liquids. They attracted significant attention in the last decade [1–3] due to their long-time stability and high potential for applications. The NBs can be applied for nanocsopic cleaning [4–7], for control of boundary slip in microfluidics [8, 9], for wastewater treatment [10, 11], for heterocoagulation [12, 13], and for medical applications [14, 15]. An extensive literature exists on the surface NBs (see, for example, [2]), which were observed using different experimental methods. On the contrary, the bulk NBs are investigated much less.

Ohgaki *et al.* [16] produced the bulk NBs mechanically with a rotary pump reaching a rather high effective supersaturation (36 for nitrogen) and related reduction of the liquid density. The effective supersaturation counts the gas dissolved in the liquid so as the gas collected in small bubbles. The bubbles were visualized by scanning electron microscopy from freeze-fracture replicas. Detailed size distribution of oxygen NBs was determined by dynamic light scattering (DLS) by Ushikubo *et al.* [17] for smaller effective supersaturation 4–5. Bunkin *et al.*

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NEWSLETTER.

JEANS & GARMENT

EDITION 20 – JANUARY 2017

Topics:

- organIQ
  - REVIEW
  - APPLICATION BY FOG SYSTEMS

EDICIÓN 20 – ENERO 2017

Temas:

- organIQ
  - UNA MIRADA RETROSPECTIVA
  - APLICACIÓN EN MÁQUINAS PARA PULVERIZADO

AS. UNIQUE SOLUTIONS

CHT BEZEMA

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5. ESTAMPACIÓN DIGITAL

Si bien es una tecnología de ennoblecimiento textil que ya puede considerarse como madura dentro del sector, es solamente desde hace unos 5 - 10 años que las empresas textiles están empezando a explotar sus posibilidades, hecho motivado sobre todo por la especialización de máquinas y nuevos desarrollos que permiten unas mayores velocidades de estampación y producción. Ejemplos de proveedores de estos equipos pueden ser:

- ATPColor,
- D-Gen,
- Mimaki,
- Mutoh,
- Durst,
- HP,
- Vutek,
- Reggiani,
- MS,
- Osiris,
- Stork,
- Konica-Minolta,
- Zimmer, etc.

Diferentes tipos de tintas pueden ser empleados en los cabezales de máquinas de estampación digital: 'Tintas Reactivas', 'Tintas Ácidas', 'Tintas Dispersas' y 'Tintas Pigmentadas'.

- Tinta Reactiva. Esta tinta es la más utilizada en la industria textil en general. Tiene casi la misma densidad de color que los colores de impresión de mallas/pantalla y es especialmente adecuada para textiles del hogar y telas de moda. Es usada para algodón, seda o incluso lana. La postimpresión, tiene que ser sometida a vaporizado a +/-102ºC para conseguir la alta calidad de colores y solidez que aportan estas tintas.

- Tinta Ácida. Es utilizada para prendas deportivas, generalmente como trajes de baño etc. hechos de nylon, licra o telas de fibra animal como la lana y la seda. También aportan una alta resistencia a la luz ultravioleta cuando se someten al proceso de vaporizado como en el caso de las tintas reactivas.

- Tinta de Colorante Dispersa. Utilizada para poliéster y empleadas de forma masiva en textiles del hogar, ropa de moda, ropa deportiva y también impresión de banderas y tejidos PES de exterior. Pueden aplicarse de manera directa o por métodos sublimables (estampación sobre papel y posterior transferencia al textil por acción de calor y presión).

- Tinta Pigmentada. Utilizada mayormente para impresión de textil con efectos de diseño/moda o en impresión de camisetas. Telas finas son las más adecuadas para este tipo de impresión, en la cual son pigmentos los que van dispersos en el seno de una resina que actúa de 'binder' entre fibra y pigmento,

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para fijarlos a la superficie textil. Se necesita alta temperatura para fijar la tinta, ya que debe secarse y curarse el binder para que fije correctamente el color.

En cuanto a innovaciones dentro de maquinaria de estampación digital, en la última feria ITMA de 2015 se presentó nuevo equipamiento. Nueva maquinaria/impresiones y tecnologías han sido desarrolladas durante los últimos años, para conseguir no solo nuevos efectos o alta coloración, sino también ahorros (en términos de agua, energía, agentes químicos…) y menos residuos/descargas. Algunos ejemplos:

DYSTAR/ZIMMER. Los tintes VAT (de indantreno) han sido reformulados por Dystar a **una nueva generación de las tintas VAT adaptadas a la impresión digital** ("primeras tintas VAT industrializadas en el mercado", dice la compañía).Ventajas:

- Alta firmeza a la luz, incluso en tonos pálidos.
- Alta firmeza a múltiples lavados.
- No hay marcas de pliegue como en impresoras de pigmento.
- Buena firmeza al frotamiento.
- Negros reales y oscuros comparados con las impresoras de pigmento.
- Tonos vívidos y brillantes.
- Excelente manejo y cubierta de telas.

También han sido desarrolladas nuevas tintas en colaboración con la manufacturera de impresoras de inyección de tinta, para adaptar algunas partes de la maquinaria. Hasta ahora, no habían tintas de esta familia química disponibles en el mercado para poder realizar estampaciones con indantreno (que requiere de reducción inicial del colorante y posterior oxidación del mismo).

Al ser un nuevo desarrollo y una nueva gama de tintas inkjet, no tienen desarrollada toda la gama de colores y los cabezales inyectores de las impresoras convencionales no sirven para estas tintas, con lo que una instalación normal digital no es adecuada y debe adaptarse. Probablemente, los inyectores comunes se degraden por corrosión de las nuevas tintas Indanthren, ya que comúnmente este tipo de colorante requiere de un proceso de reducción alcalina + posterior oxidación para su fijación. Esa puede ser la razón por la cual Dystar está trabajando junto con Zimmer en este sentido.

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ITMA 2015

DyStar, Zimmer Austria present digital printing innovations

Posted January 18, 2016

MILAN – DyStar and partner Zimmer Austria presented their most recent innovations in the digital printing market at ITMA.

The digital printing market has developed a great deal since the last ITMA in 2011. Innovations in the digital printer and print-head technology drove the transformation into an upscale industrial digital printing production.

New inks must meet these new requirements. They need tighter drop forming performance, longer open time, improved stress resistance, higher color strength, improved robustness and, of course, reliable eco-performance and highfastness properties.

In response to the new industry standards, DyStar launched Jettex® 4.0 – the highest performing digital textile printing inks. The Jettex 4.0 ink ranges are available for all state-of-the-art and newly introduced print heads.

Representing Zimmer Austria are (L-R) Regina Triebnig, Stuart Kugler and Luise Hausberger, standing in front of the Colaris-3 digital printing machine.

Reactive, acid, disperse and sublimation inks

DyStar´s new ranges of market leading, ultra-intense inks show improved longer life time and user-friendly open time for the print-heads, with excellent robustness in processing. They also meet the most stringent ecological and fastness requirements, the company said.

All newly launched Jettex Black inks exceed current limits and are setting new industry benchmarks towards deepest blacks.

New vat inks

Thus far none of the digital printing systems could fulfill the very highfastness requirements on inks in the home textile segment, e.g. the very highfastness to light (especially in pale shades), highfastness to multiple washing and fastness to rubbing, according to DyStar.

Based on their Indanthren® Vat dyes, DyStar developed Jettex Vat inks, which the company said is the first industrialized vat inks on the market. Their high-performance characteristics include:

- Highfastness to light, even in pale shades
- Highfastness to multiple washing
- No crease markings like pigment prints
- Good fastness to rubbing
- Real, dark blacks compared to pigment prints
- Vivid, brilliant shades
- Excellent handle and drape of fabrics

The new Jettex Vat inks are the a for the home textile market, DyStar said. The CMYK color set is already available and DyStar will launch more shades in 2016 to offer a complete range to industries with high performance requirements.

ZIMMER AUSTRIA and DyStar have partnered for many years in developing inkjet technology. This cooperation is also the base of the VAT inkjet printing technology used in Zimmer's Colaris high-performance inkjet printer. Zimmer's Colari. is based on the Fuji Dimatix Starfire technology which is one of the most robust and reliable printheads on the market using a circulation system, according to the company.

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DyStar

Products Services Solutions Sustainability

23 Dec New Digital Printing Innovation presented by DyStar® and ZIMMER AUSTRIA

Posted at 21:31h in Uncategorized · SHARE

DyStar and Zimmer Austria presented the most recent innovations in the digital printing market at ITMA Milan.

The digital printing market has developed a great deal since the last ITMA in 2011. Innovations in the digital printer and printhead technology drove the transformation into an upscale industrial digital printing production.

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Reactive, Acid, Disperse and Sublimation Inks

DyStar´s new ranges of market leading, ultra-intense inks show improved longer life time and user friendly open time for the printheads, with excellent robustness in processing. They also meet the most stringent ecological and fastness requirements.

All newly launched Jettex Black inks exceed current limits and are setting new industry benchmarks towards deepest blacks.

New Vat Inks

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ZIMMER AUSTRIA and DyStar have been partnering for many years in developing inkjet technology. This cooperation is also the base of the VAT inkjet printing technology used in Colaris^3.

VAT inks are highly pigmented inks and to allow a reliable inkjet operation it has turned out that only circulating printheads can be used. Zimmer's Colaris^3 is based on the Fuji Dimatix Starfire technology which is one of the most robust and reliable printheads on the market using a circulation system.

Fixation of VAT inks can be done in a 1 phase or 2 phase system. Right now ZIMMER AUSTRIA and DyStar are developing the optimized fixation system for VAT inks. The plan is to offer a workable system within 2016 which can change the inkjet printing industry for the home textile, work wear and military market.

Colaris^3 is the high performance inkjet printer for industrial print applications ranging from fashion over home textiles, polyester fleece products to carpet. ChromoJET digital inline application of pre-treatments, Colaris^3 with medium or large droplets and the SupraPRESS penetration unit have opened up complete new applications in printing terry towels, fleece, needlepunch products and carpets. Print results and penetration levels and production speed are outstanding in the industry.
http://www.zimmer-kufstein.com/pdf_colaris3

For fashion printers Zimmer offers Colaris Infinity based on SPT 1024 print heads with 7 pl droplets. This printer with 4, 6 or 8 colors and 2 or 4 printheads per color delivers up to 300 m2/h at 360 * 720 dpi resolution in 1.8 m print width. The price is very competitive for such a high quality industrial printer.
http://www.zimmer-kufstein.com/colaris_infiniti_sk

To be prepared for the digital future ZIMMER AUSTRIA will open up in May 2016 a new technology center in Kufstein/Austria. The 2000 m^2 building will host all kind of digital print and process technologies for the textile and carpet industry. The goal is to bring customers to Kufstein for evaluation of the best technology and for training.

SGPRINTS. Una **nueva generación de maquinaria+tintas curables por UV** tiene cada vez más presencia dentro del sector textil de la estampación digital. Se requieren nuevos agentes químicos para desarrollar estas nuevas tintas, los cuales **no** son **a base de agua o de solventes sino de resinas que curan por acción de radiación UV**.

La curación de la tinta se consigue a través de lámparas o LEDs UV.

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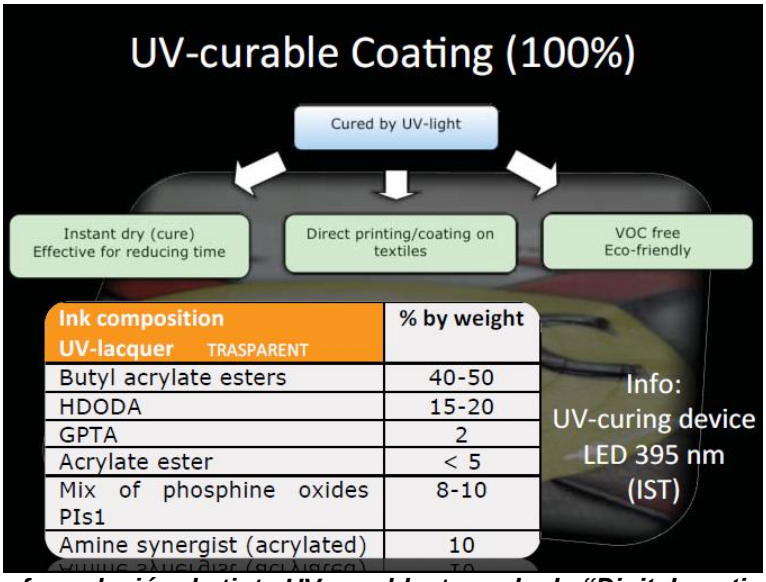

Ejemplo de una formulación de tinta UV-curable, tomada de "Digital coating technologies - an update". Marc Van Parys. TCL 2014, Cannes (Francia).

Las impresoras de curado por UV presentadas por SGPRINTS tienen estas especificaciones de la lista siguiente:

- Velocidad de producción: hasta 700 m^2/h.
- Colores brillantes y buena resolución.
- Capaces para imprimir textiles o papel.
- Anchuras: > 3.20m (para formatos medios/amplios).

REGGIANI. La compañía estrenó hace un par de años su nueva impresora ReNOIR NEXT, un **producto versátil que imprime bien en tejido o en papel utilizando el mismo set de tinta** con un sistema de impresión digital sin correa de 1.8m.

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Esta máquina aporta **versatilidad en línea con productos de moda, customización y personalización de producto y capacidad de trabajar con volúmenes variables de carga de trabajo.**

Como resultado, los clientes pueden aprovecharse de la capacidad de esta tecnología digital para poner en marcha muestras o bien procesos de producción, conjugados con un coste efectivo y un modelo de negocio respetuoso para el medioambiente.

Otras ventajas y tecnologías desarrolladas por Reggiani en los últimos tiempos:

- **La impresora TOP,** con una calidad líder en la industria, y una de las matrices de inyección de tinta más robustas en el mercado, se exhibió en ITMA 2015. Disponible en amplitudes de 1.8m y 2.8m, **está especialmente diseñada para la estampación con tintas reactivas sobre algodón.**
- La **caja de lavado de Essetex de amplitud 2m,** es el sistema ideal **para tejidos ligeros y de punto**, particularmente donde el lavado es necesario y beneficioso para textiles delicados.
- **Nueva química ecológica:** todos estos sistemas digitales de inyección de tinta están basados en la química ecológica, utilizando **tintas acuosas que, junto con la automatización avanzada y optimizada,** proporcionan una solución sostenible para negocios textiles. Las tintas acuosas están desarrolladas para ser **respetuosas con el medioambiente con una significante reducción de la contaminación sin comprometer la calidad ni la velocidad** de proceso.
- Nuevas tintas: las nuevas **tintas Artistri PK2600 desarrolladas por DuPont para textiles de algodón procesados en impresoras EFI Reggiani.** Las nuevas tintas ofrecen **color y una caída/mano comparable a la impresión reactiva, con un excelente rendimiento de solidez** y el mejor rendimiento de impresión de su clase, sin pasos de proceso de vaporizado o lavado que retarden el proceso de impresión.

ZIMMER, DURST, MS, MIMAKI. Todos presentaron **nueva maquinaria y diseños centrados en la maximización de la productividad y uso de tintas pigmentadas.**

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1) *Zimmer COLARIS³DX+Magnoroll for heavy fabrics.*
2) *Durst inkjet printers for pigments. Resolution: 600 ppp.*
3) *MS inkjet printer for pigments. For high colour fastness.*
4) *Mimaki inkjet printers for sublimation or UV-curing.*

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6. EQUIPAMIENTO PARA TINTURA

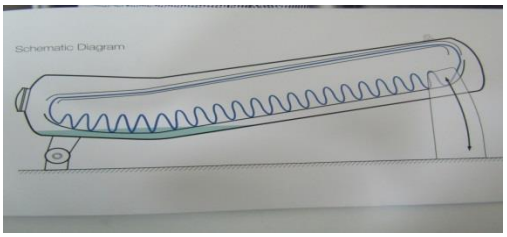
El nuevo equipamiento para procesos de tintura textil, del cual muchas novedades también tuvieron presencia en la última edición de ITMA Europa, cada vez está siendo más desarrollado buscando conseguir no solo nuevos efectos o alta coloración, sino también ahorros (en términos de agua, energía, agentes químicos…) y menos residuos/descargas.

Los nuevos diseños de máquinas de tintura que permiten minimizar los ratios de baño de colorante suponen ahorros medioambientales = ahorros monetarios. Algunos ejemplos se muestran a continuación:

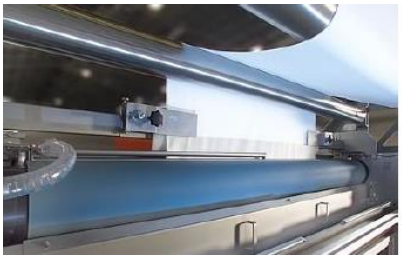
MCS. Nuevos diseños que minimizan el consumo de agua. Además, presentan nuevos diseños de cajas de desapresto adaptadas antes del rame/horno.



THEN SUPRATEC LTM-FONG's. Un nuevo diseño de máquina de tintura que es capaz de modificar su posición y su ratio de baño de colorante (de 1:5.5 a 1:15) para optimizar el proceso de tintura mientras este se va realizando. Adecuado para tejidos de calada y punto.



KUSTERS - BENNINGER. Alta flexibilidad, reproducibilidad y muy fácil gestión, este sistema puede tintar amplios formatos incluso con colorantes reactivos; también puede ser adaptado a longitudes cortas/medias de rollo de tejido.



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MONFORTS. Un sistema basado en proceso Termosol que es capaz de modificar su distancia entre los cilindros de exprimido, para evitar arrugas, dobleces y que además es capaz de procesar sin problemas tejidos con lycra. Además, la impregnación puede ser controlada automáticamente.

JUVER. Máquina de tintura en cuerda que proporciona un bajo ratio de baño de tinte con un menor consumo de agua. Pueden ser tintados 30kg de materia. La versión Turbo-lab puede ser adaptada para pequeñas cantidades de material textil a tintar.

NOSEDA 1893. Sistema Aquazero. Ratios de baño de tintura muy pequeños para hilo (bobina) o tintura de prendas.

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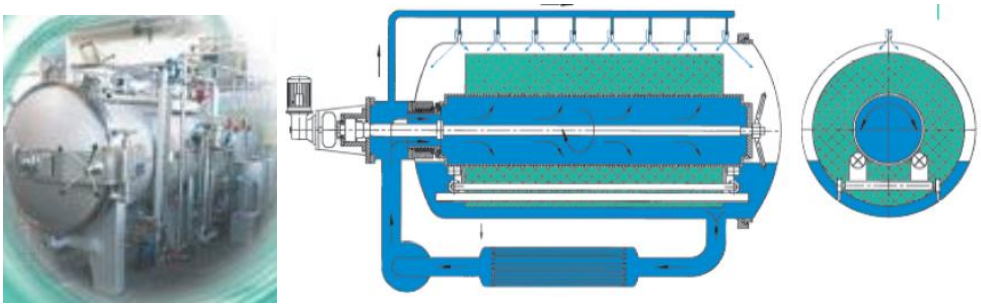
ALLIANCE TEXTILES - ROTORA. Máquina de tintura por autoclave con una distribución optimizada del baño de tintura dentro de la cámara.



THIES TEXTILMASCHINEN. Después de la satisfactoria implementación de las últimas máquinas de tintura de prendas iMaster H2O y soft-TRD SIII, Thies Textilmaschinen introdujo su novedosa máquina de tintar hilos iCone en el ITMA de Asia que tuvo lugar en junio del 2014. El nuevo desarrollo está centrado en consolidar los más altos estándares ecológicos con inteligencia artificial para conseguir grandes ahorros en el consumo de agua y electricidad. Su novedoso sistema de bomba de bloque permite la tintura con un ratio de licor ultracorto. Dependiendo del movimiento del material, ratios de licor de 1:3.6 son posibles. Las funciones de enjuague mejoradas permiten la reducción del tiempo de post-tratamiento en casi una hora. Además, el nuevo diseño de la tubería de succión permite el ajuste de la inversión de flujo.

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MASTER. La máquina IndigoRope Genius/C para tintura con índigo de carácter ecológico y tintura de sulfurosos. En 2013, la empresa italiana Master S.r.l. la puso en el mercado combinando su máquina de tintura de cuerdas IndigoRope con el nuevo módulo de tintura integrada Genius/C para crear la máquina de tintura IndigoRope Genius/C destinada a la tintura ecológica de índigo. La nueva tecnología mejora la maquinaria tradicional de tintura de cuerda con la adición del módulo Genius/C (un sistema medioambientalmente sostenible que permite la difusión de colorante y fijación del mismo bajo condiciones leuco, utilizando una activación por calor que puede modularse en función del proceso y el material, así como variando también tiempos de proceso). El módulo también sumerge el hilo en el colorante y lo exprime para eliminar el exceso.

El nuevo módulo ofrece las siguientes ventajas ecológicas y económicas sobre sistemas tradicionales:

- Tintura mejorada con índigo y mayor penetración de tintes sulfurosos, mayor difusión y mejor fijación en la fibra;
- Menor volumen del baño de tintura;
- Aproximadamente un 50% de reducción en consumo de hidrosulfito y sosa;
- Menos consumo de agua de lavado;
- Menos sulfitos y sulfatos en las aguas residuales.

El entorno de trabajo con sistema de teñido leuco hace que se genere una reducción química del índigo optimizada, la cual puede incluso eliminar la necesidad de un agente fijador posterior.

Estas nuevas tecnologías de maquinaria/tintura son capaces de alcanzar importantes ahorros en términos de agua, energía, agentes químicos, etc. y menos residuos/descargas, y ya pueden ser consideradas como tecnologías maduras y totalmente aplicables a escala industrial. En cualquier caso, más avances técnicos y nuevas mejoras en consumo de agua, de energía, eficiencia, etc. se esperan en la maquinaria de tintura en los próximos años. Aportarán al proceso de fabricación textil:

- Menos agua a utilizar para tintar.
- Menos químicos utilizados para tintar.
- Menos energía utilizada.

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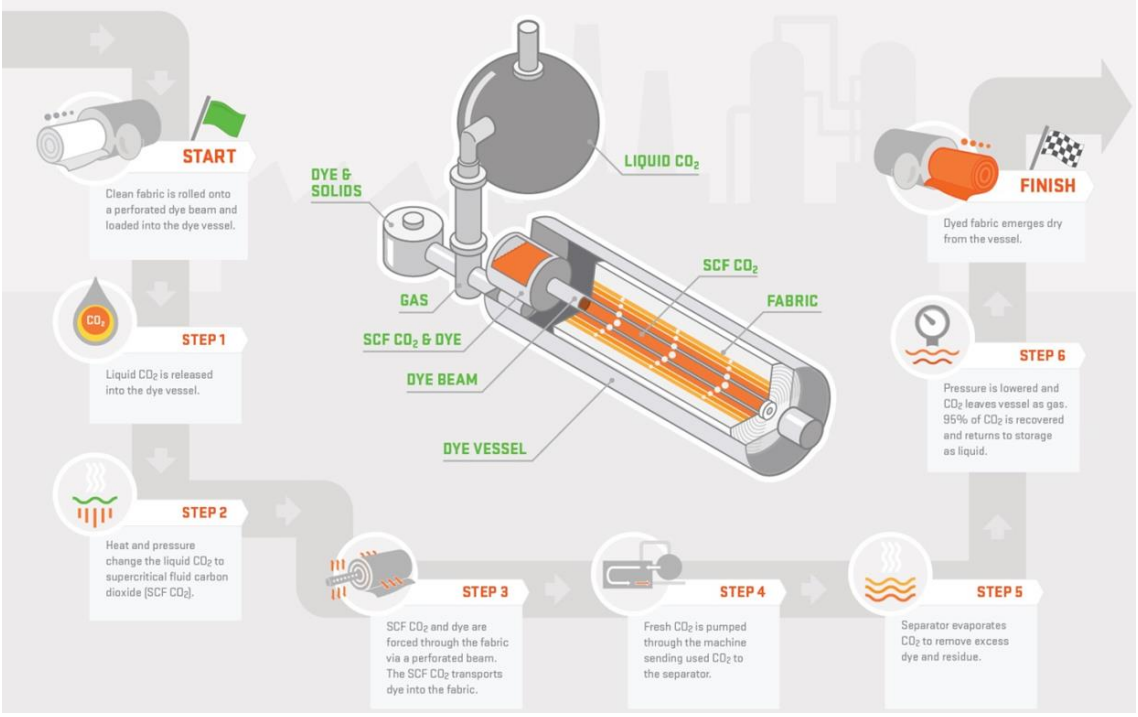
- Menos residuos/descargas.
- Eficiencia incrementada.
- Nuevos efectos o alta coloración.
- Ratios de baño de tintura minimizados.

Además, deben tenerse en cuenta ciertas buenas prácticas en procesos de tintura que también contribuirían a una mejora del carácter medioambiental y sostenible de estos procesos de ennoblecimiento textil. Algunos ejemplos:

<u>Implementar procesos de tintura en "seco" basados en tecnología de Fluido Supercrítico:</u>
NIKE Inc. anunció en febrero del 2012 su participación en la puesta en marcha de la empresa holandesa, DyeCoo Textile Systems B.V., una compañía que ha desarrollado una tecnología para reemplazar el agua utilizada para tintura por CO2 (gas que se comporta como un líquido por debajo del estado de fluido supercrítico), reduciendo la energía utilizada y eliminando la necesidad de añadir agentes químicos al proceso.



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Implementar procesos de tintura en “seco” asistidos por nanoburbujas en prendas para efectos de moda.

La tecnología de micro-nanoburbujas permite la aplicación de tratamientos de acabado en prendas, incluso en procesos de tintura.

Equipamiento y efectos de tintura por nanoburbujas (de Jeanologia).

El proceso de e-Flow para tintura evita el uso de alta cantidades de agua, energía y agentes químicos, y efectos especiales (overdye, maltinto, etc.) podrían ser obtenidos en las prendas.

Implementar nuevos tintes y colorantes provenientes de recursos naturales:

- Los colorantes provenientes de plantas y recursos naturales pueden ser utilizados como materia prima colorante alternativa. En este caso, un agente químico conocido como ‘mordiente’ y la preparación de la tela de manera adecuada es requerida para incrementar la solidez de lavado del tinte.

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- Archroma lanzó en 2014 una novedad en el rango de los colorantes "biosintéticos" para tejidos de algodón y celulósicos conocida como EARTHCOLORS, los cuales provienen de cáscaras de almendra, palmito salvaje, hojas de romero y otros productos naturales. Estos pueden ser utilizados para proporcionar colores fuertes en tono rojo, marrón y verde para dénim y ropa casual. Los nuevos tintes (tintes biosintéticos sulfurosos) tienen el rendimiento global que ofrecen los colorantes sulfurosos habituales, pero sintetizados a partir materia prima natural.

<u>Control ecológico en procesos de tintura (con colorantes reactivos) para tejidos de celulosa:</u>

- Útil para procesos de tintura en continuo. Tintura con foulard / pad-dyeing.
- Uso de colorantes reactivos con alta reactividad y afinidad (p.ej. Levafix CA).
- Modificación de parámetros usuales durante el proceso de tintura. Aplicar el proceso usual de tintura pero utilizando un agente humectante y un álcali a un pH=8-9. Esto evita el uso de urea, sales o silicato sódico.
- Presecar la tela a 68-69ºC; aplicar el proceso de tintura a 120-130ºC durante 2-3' (bajo el 20-25% de humedad presente en la tela). Lavar la tela con normalidad.

<u>Sustitución del hidrosulfito sódico al tintar poliéster con colorantes dispersos:</u>

Algunas alternativas químicas están disponibles para la reducción de carga químico en el proceso de lavado/enjuague:

- Dióxido de tiurea.
- Hidroxiacetona.

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Pre-lavado/humectación + proceso de tintura en 1 paso para tintura de poliéster (colorantes dispersos):

- Usar tensioactivos especiales.
- El proceso alternativo podría ser: 1) Prefijado-termofijado (rame); 2) Lavado/tintura; 3) Reducción del lavado; 4) Enjuague.
- Modo de operación: añadir 3-5% de un tensioactivo/dispersante especial (p.ej. Dispergal PCS) cuando se rellena la máquina. Entonces, ajustar el pH a 4.3-5.5 e introducir los colorantes dispersos que vayan a ser utilizados.
- Empezar el proceso de tintura.

Sustitución de agentes dispersantes comunes por agentes dispersantes biodegradables:

- Disponibilidad de ésteres de ácidos grasos.
- Disponibilidad de sales de sodio (mezclas), compuestos aromáticos y/o ácido sulfúrico.

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7. SISTEMAS DE LAMINACIÓN HOTMELT

Complementando la investigación que se realizó en lo que respecta a sistemas de ennoblecimiento textil por vía húmeda, se ha querido cerrar este apartado dejando constancia aquí también de la cada vez más creciente tendencia de uso de la tecnología hotmelt en sistemas de laminación textil.

Los adhesivos hotmelt o termofusibles son 100% sólidos y están basados en polímeros termoplásticos. No contienen agua ni disolventes. Se funden por acción de calor, aplicándose en estado líquido en una de las superficies. Tras unir las dos superficies y aplicar presión sobre ambas, el calor acumulado va disminuyendo con el tiempo, el adhesivo se enfría y comienza a solidificar. Es entonces cuando se produce la adhesión mediante hot melt. Destacan por su extraordinaria adhesión a multitud de sustratos, teniendo aplicación en sectores tan diversos como la industria textil, calzado, automovilística, mueble, construcción, embalaje, artes gráficas, etc.

No cabe duda de la importancia y del fuerte crecimiento de los adhesivos hot melt en el mercado actual, cuyas ventajas representan una alternativa a los adhesivos en base disolvente, cada vez más restringidos por la legislación. Su rápido procesamiento, versatilidad, no toxicidad, respeto al medio ambiente, su alto rendimiento en aplicaciones avanzadas y su facilidad de uso, hacen que los adhesivos hot melt se consoliden cada vez con gran facilidad en más sectores industriales.

La tecnología hot melt dentro del sector textil puede considerarse como madura, tras un periodo de penetración y consolidación de cerca de 10 años, desde el año 2000 aproximadamente. La variedad en sistemas aplicadores de los adhesivos, la posibilidad de trabajar con termoplásticos o reactivos y el amplio rango de aplicaciones técnicas y usos finales que pueden desarrollarse hace que la tecnología hot melt sea muy adecuada para desarrollar textiles multicapa destinados a usos altamente técnicos. El sistema de aplicación ‘gravure roller’ (cilindro grabado, por puntos) es de los más empleados en textil.

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Hay que tener en cuenta que los adhesivos para laminado o unión de substratos textiles destinados a diversos usos industriales pueden encontrarse en 3 formatos básicos:
1) base agua,
2) base disolvente y
3) en forma sólida (granza, barras, pastillas) para su aplicación como hotmelt.

TIPOS DE ADHESIVOS SEGÚN FORMATO			
	Base acuosa	***Base disolvente***	***Hot-Melt***
Forma de presentación	Solución o dispersión acuosa	Solución en disolvente	Polvo, granza, barra, film
Ventajas	- No inflamable - Seguro - Fácil limpieza - Fácil almacenado	- Secado rápido - Buena resistencia agua - Fácil humectación del substrato	- Limpio - No necesita secado - Sin emisión humos - Unión instantánea - Fácil almacenado
Limitaciones	- Energía de secado - Proceso lento - Bajo contenido en sólidos - Duración limitada	- Humos/legislación - Necesidad extracción - COVs y almacenado - Riesgo incendios	- Instalaciones caras - Calor para activación - Experiencia
Coste	- Bajo/moderado	- Moderado/alto	- Gránulos: bajo/moderado - Polvo: bajo/moderado - Barra: moderado/alto - Film: moderado/alto

Características principales que definen a cada tipología o familia de adhesivo industrial, según el formato en el que se encuentra (base acuosa, base solvente o hotmelt).

Los polímeros hotmelt no son relativamente nuevos dentro de los polímeros o de las resinas industriales. De hecho, se están utilizando desde hace mucho tiempo en diferentes sectores (nonwovens, papel, películas fotográficas, papel de aluminio,…) principalmente como adhesivos. Por lo que respecta a la industria textil, los hotmelts se utilizan en la actualidad, casi exclusivamente para laminar, en la producción de muchos artículos como lencería, ropa de trabajo, prendas de vestir, ropa protectora,…).

Durante los últimos años, los hotmelts han ganado interés en la industria automovilística como un sustituto ecológico para la técnica de laminación por llama (o también denominada foamizado a la llama). La laminación por llama tradicionalmente se usa para laminar un tejido con una espuma de poliuretano (PU), pero esta técnica actualmente se enfrenta a mucha presión medioambiental y posiblemente desaparecerá pronto. La laminación por llama causa una reacción de reducción de la espuma de PU liberando una variedad de materiales volátiles incluyendo isocianatos y cianuro de hidrógeno. Varios productores ya han sustituido esta técnica por la laminación con adhesivos hotmelt. Aunque el potencial de los hotmelts es mucho mayor que la laminación, los hotmelts actualmente se utilizan muy poco en los recubrimientos textiles.

Una posible explicación es el hecho que se tienen que cumplir funcionalidades específicas para una gran gama de recubrimientos textiles. Puesto que se carece de los conocimientos para funcionalizar los polímeros hotmelt en la industria textil, y que los hotmelts funcionales comercializados son escasos todavía, su aplicación en este campo está limitada existiendo un gran potencial de mercado en este sentido.

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Y en cuanto a sistemas aplicadores de uso textil y para desarrollos en continuo, pueden identificarse hasta 4 sistemas principales:

- Slot-die (mediante boquilla).
- Dot coating/engraved roll (cilindro grabado).
- Spraying/fiberizing (pulverizado).
- Powder scattering/scatter coating.

Varios fabricantes de maquinaria se están haciendo un hueco en el mercado: Coatema, HIP-MITSU, Indutech, Jakob Weiß & Söhne Maschinenfabrik, Lacom, Nordson, Monti Antonio, M+S Group, Santex/Cavitec, Stork, WEB Processing,… son solo unos cuantos ejemplos de fabricantes de maquinaria para hotmelts. Cada uno de ellos está especializado en diferentes sistemas aplicadores y tecnologías… y cada una de ellas aporta unas ventajas y limitaciones que influyen según el uso final pensado para los materiales a recubrir o laminar. Por tanto, debe tenerse muy en cuenta la idoneidad de cada sistema según que el artículo final que quiera obtenerse.

-- bad - limited o neutral ++ optimal + good	Scatter Coating	Roll Coating	Slot die Coating	Fiberiz. Coating
Variation of application weights	o	o	++	++
Speed range	--	o	++	+
Breathable Bonding	++	++	--	++
Impact of application by the thickness of the substrates	++	o	+	++
Coating on open structures	--	o	+	+
Cleaning and heating times	++	--	+	+
Operating – and maintanance costs	+	o	o	o
Energy efficiency	--	-	++	++
Space needed	--	o	o	++

Comparación de las 4 tecnologías principales de aplicación de hotmelts (Extraído de "Adhesive Application Methods in the Technical Textile Industry". S. Schultheis. TCL2012, Valencia - España).

Por último, en los procesos de laminación textil pueden además implementarse tecnologías y procesos de tratamiento superficial para incrementar la humectabilidad y capacidad de adhesión de los materiales intervinientes -sobre todo si son de carácter sintético-, tales como las tecnologías de plasma a baja presión, por descarga corona o plasma atmosférico.

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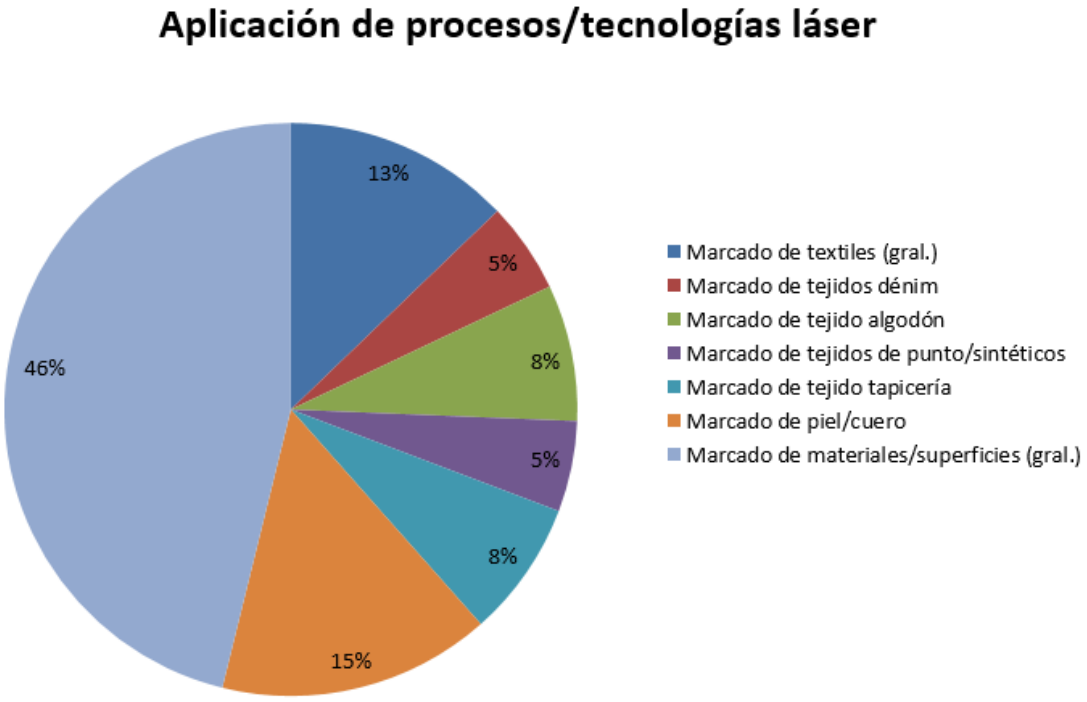
8. CONCLUSIONES

Las conclusiones referentes a la investigación en nuevas tecnologías y procesos de acabado sostenible son:

- Cada vez es más importante, no solo para la propia industria textil en sí, sino también para la percepción del consumidor final de textiles, la importancia de implementación y desarrollos de procesos de fabricación medioambientalmente sostenibles. Esto es de vital importancia en procesos de ennoblecimiento textil, que son masivos en el consumo de agua, químicos y energía, y en el vertido de efluentes y carga química de los mismos.

- En cuanto a la tecnología láser, se han identificado diferentes opciones de tratamiento, tanto en plano (tipo mesa) como en continuo así como con posibilidades de robotización del equipo láser que permita el tratamiento en puntos específicos o el marcado de piezas 3D. El análisis de patentes y documentación técnica se ha realizado en función de fecha de publicación de documento y temática del documento, para establecer unas conclusiones de utilidad para el trabajo experimental de FUN2GARMENT.



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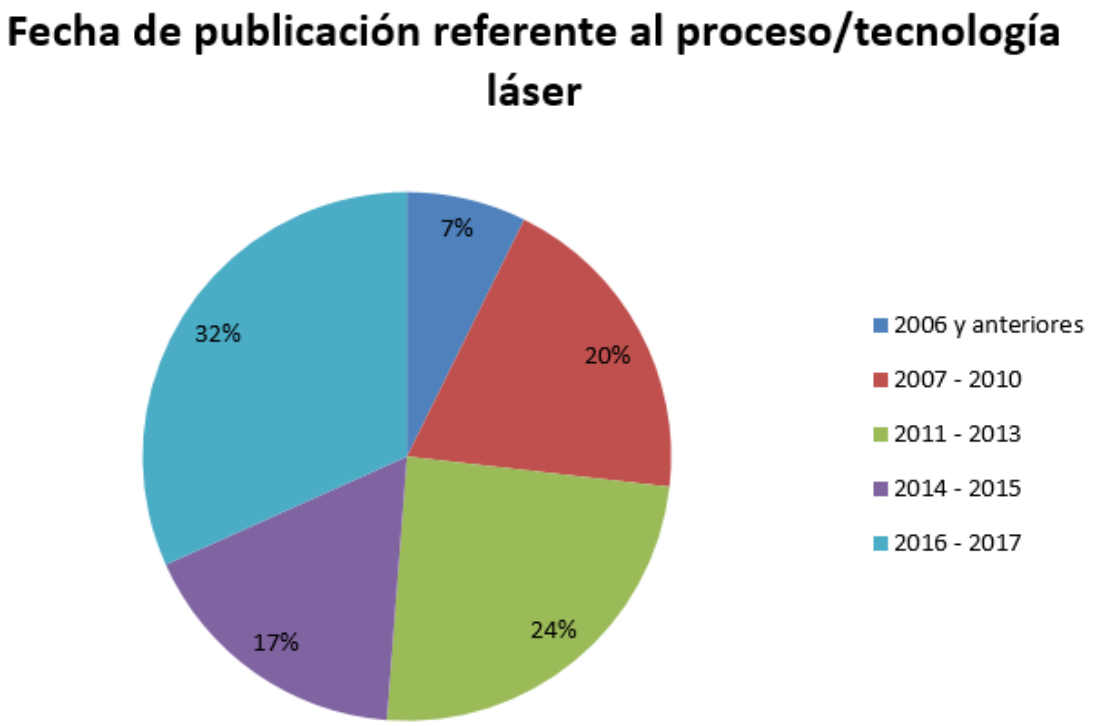

- Se observa, en cuanto a fecha de publicación de documentos técnicos o patentes una tendencia creciente en cuanto a novedad de la tecnología, ya que de todos los documentos investigados el 32% de ellos se sitúan entre 2016 - 2017, y el 49% entre 2014 - 2017. Puede afirmarse que la tecnología láser, a pesar de ser casi considerada como madura dentro del sector textil y otros sectores industriales todavía no ha alcanzado su máximo en cuanto a penetración, conocimiento de la misma e implementación en procesos productivos de marcado y acabado.

- Igualmente, en lo que respecta a aplicaciones del láser, puede verse que se emplea para usos muy variados (muchos de los cuales se han identificado en este estudio, como marcado de madera, plástico, metal e incluso de fruta como alternativa al etiquetado con papel/adhesivo). Dentro del sector textil y por la novedad de documentos estudiados, ya se identifican nuevas aplicaciones alternativas al marcado sobre dénim, viendo que usos sobre piel/calzado así como sobre tejidos de punto e incluso sintéticos empiezan a aparecer. Puesto que el marcado dénim es el primero que apareció, no tiene un peso significativo en este estudio precisamente porque la búsqueda de información ha tratado de ser lo más novedosa posible.

- Respecto la tecnología de ozono y tratamiento de materiales y compuestos con ella, el estudio ha permitido claramente identificar 3 vías de trabajo con esta tecnología: tejidos naturales para decoloración+bleaching, higienización/esterilización de bienes de consumo y tratamiento de aguas. Se ha identificado incluso la posibilidad de decoloración de piel/cuero, que puede ser una nueva línea a implementar en próximas acciones de FUN2GARMENT.

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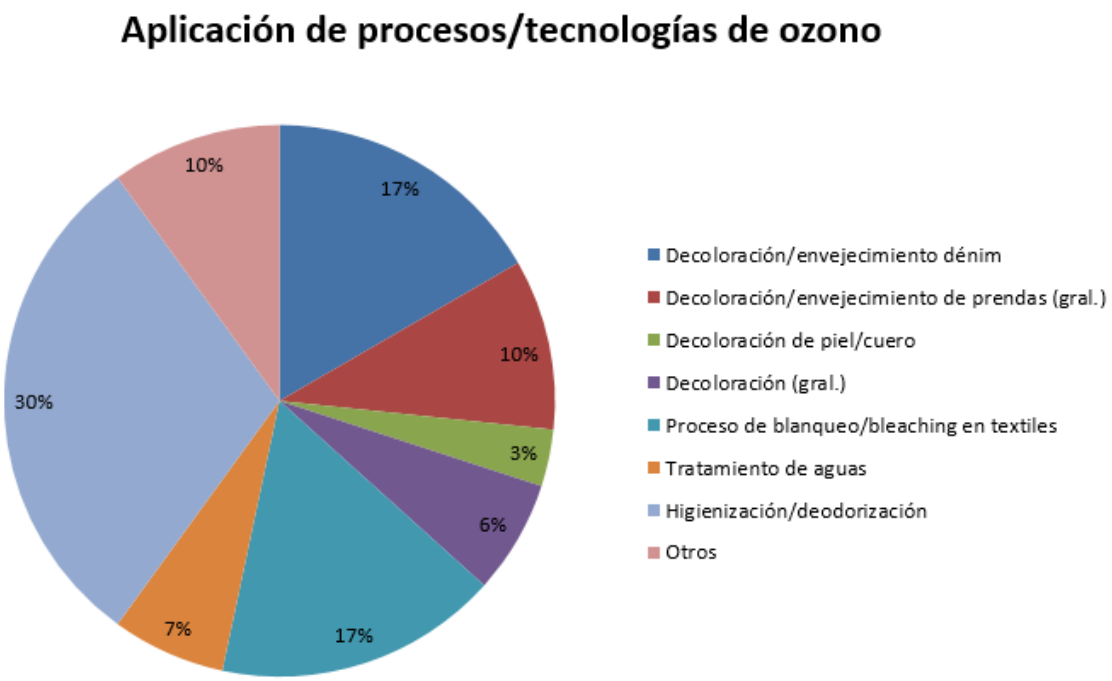

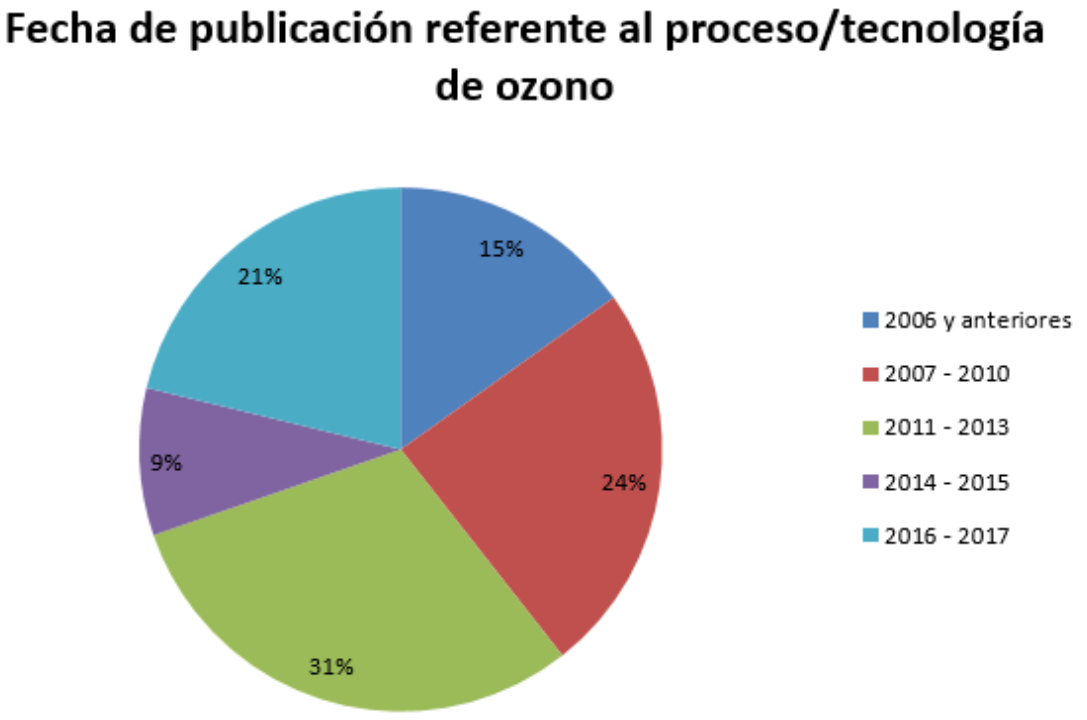

- La novedad de la tecnología de ozono ya no sigue los patrones de la tecnología láser, puesto que solo el 21% de documentos investigados tienen fecha de publicación 2016 - 2017. La mayoría de ellos (55%) fueron publicados entre 2007 - 2013, lo cual indica que los sistema de ozonización ya son bien

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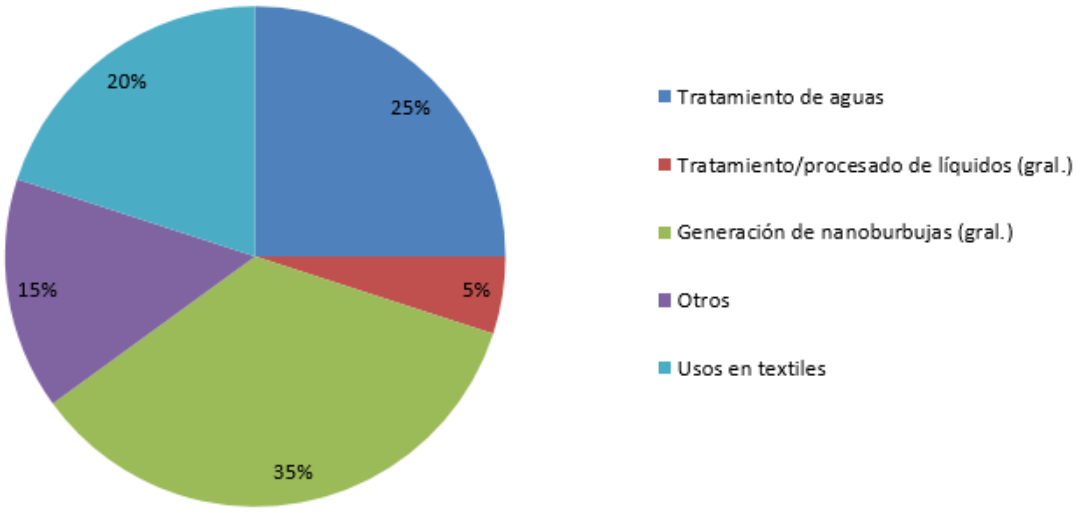
conocidos y están implementados en diferentes usos industriales. Aún así, el estudio por aplicaciones realizado muestra que sobre materiales tales como piel/cuero o como procedimiento alternativo de blanqueo/limpieza de textiles todavía hay camino por recorrer.

- Por último, el análisis de documentos especializados en tecnología de micronización / nanoburbujas muestra la novedad de estos procedimientos de transporte de materia, incluyendo usos en textil.

Aplicación de procesos/tecnologías de micronización / nanoburbujas



- 3 temáticas principales se han identificado en cuanto al estudio de información técnica: los propios procedimientos de generación de nanoburbujas y caracterización de dinámicas de generación, transporte, difusión, etc., el tratamiento de aguas (permitiendo mayor aireación y aporte de oxígeno) y varios usos identificados en textiles, como los previstos en FUN2GARMENT. Cabe indicar que en la industria farmacéutica, química o alimentaria también se han identificado usos de esta tecnología. Puede considerarse totalmente emergente dentro del sector textil y no madura incluso en el resto de sectores, a tenor del análisis de fechas de publicación de los documentos investigados.

- Así, 3 de cada 5 documentos investigados se publicaron entre 2016 y el periodo de ejecución de FUN2GARMENT, lo cual da una clara idea de la novedad de esta tecnología, y motiva investigar sobre ella y las aplicaciones que puede tener para el acabado textil ya que acabados diversos, tinturas, tratamientos enzimátcos, etc. se aplican npor vía húmeda y con líquidos de baja viscosidad susceptibles de ser nebulizados y transportados vía nanoburbujas.

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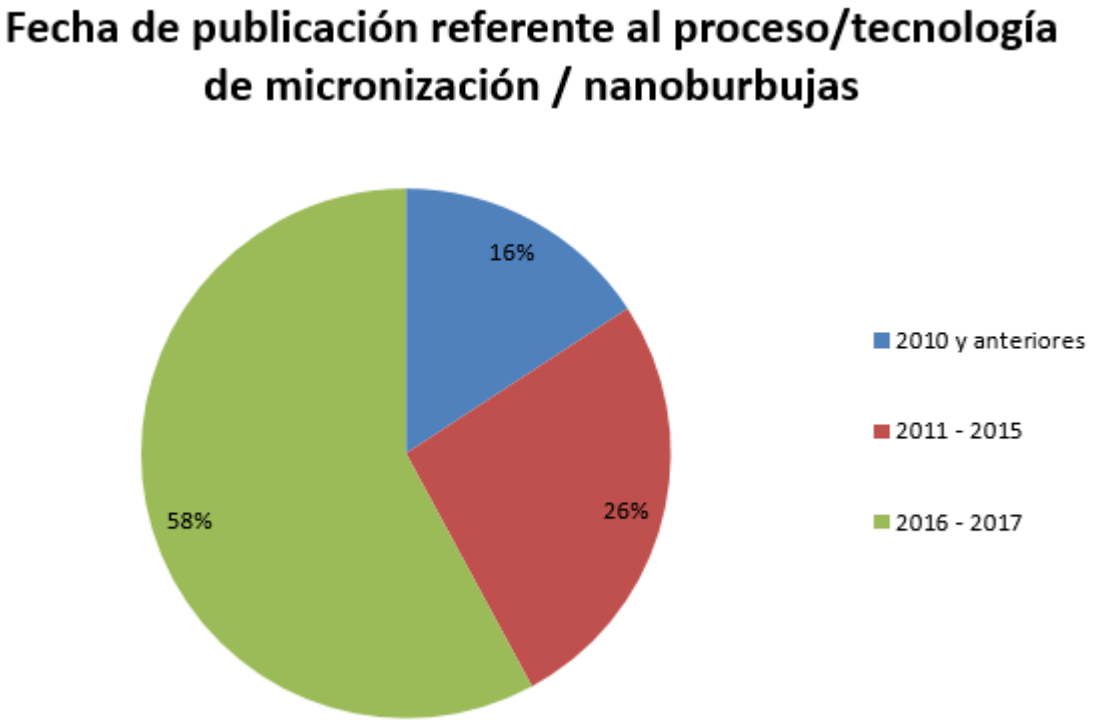

- Otra información de interés, sobre todo en procedimientos y tecnologías de estampación digital y tintura ha sido también analizada, mostrando que la novedad de procesos y maquinaria es cada vez más creciente en su vertiente medioambiental. Muchos de los desarrollos de los 2 últimos años vienen marcados por equipamiento que permite aumentar velocidades de producción, procesar textiles con consumos menores de agua y energía, o reducir gastos de productos químicos y, por tanto, generar menos efluentes líquidos con una menor carga contaminante.

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