



Concentrol[®]
Chemical Solutions

RELEASE AGENTS FOR THE FOOTWEAR SECTOR

STATE OF THE ART

White paper with studies on release agents for the
footwear sector developed at CONCENTROL R+D
laboratories

WHITE PAPER





Concentrol

Performance Materials

INDEX

Introduction	2
Types of release agents for polyurethane footwear soles	3
The choice of a footwear release agent	8
Water based release agents for phylon	12
Success Story - Footwear Sector.....	13
Footwear sector: Concentrol's water-based mold release agents, for single and dual density soles.....	14



Introduction

At Concentrol we are experts in mold release agents, and one of our specialities is mold release agents for shoe soles. The knowledge and experience on the raw material used and on the needs of the product are key to offering the best solutions to manufacturers.

In the case of shoe soles, depending on what footwear's sole component (polyether or polyester), one or other Concentrol demolding agent is applied.

Needs according to types of soles

Depending on the type of sole that is used, a different release agent is required. Apart from the material used (polyester or polyether), we must bear in mind that currently on the market we find two types of soles (one density or two densities), which require different injections.

In any case, the objectives of the mold release agent are the same: to achieve a high demolding power, impeccable finish in terms of shine and uniformity of the surface, low mold fouling and adaptation to the complexity of the parts depending on fashion.

In order to ease the process by eliminating adhesive and sewing, thanks to the high quality of our shoe release agents we can make a direct injection of mono and bi-density soles. The choice of a good release agent is very important here, as the result has to be a perfect sole, uniform shine, excellent demolding, low fouling and, where appropriate, good adhesion between the sole and the midsole.

Main objectives

At Concentrol we work with the commitment to always achieve the highest quality in our products. Mold release agents for shoe soles are one of our specialities and we have achieved some of the main features required by the product according

to each manufacturer's needs. Following we outline some of the advantages of Concentrol's release agents for footwear soles: firstly, we highlight the high release capacity, the perfect adhesion on bi-density soles, a level of shine and optimal surface finish and compatibility with subsequent treatments. Also we highlight the differentiation of products according to whether they are polyether or polyester soles.

Another of the goals achieved by our footwear release agents is that they are solvent-based and water-based products with low levels of rejection. In addition, they cause low mold fouling. Regarding the environment, we highlight the low emissions of VOC and the possibility of DBT or tin free products.

In order to present to our clients that the extensive range of water based, solvent based and hybrid release agents offered by Concentrol comply with all the rules and regulations as well as the quality of their performance and guarantee of results, we have prepared this document, which includes the different studies with the technical detail of the products.



Types of release agents for polyurethane footwear soles

INTRODUCTION

Polyurethane was introduced in the footwear sector in the late 60s, and since then it has become a very popular material for shoe manufacturers, since this material allows to obtain quality shoes, comfortable and durable, as well as light, at a low price.

Its appeal lies in the high amount of footwear that is manufactured globally every year. The "World Footwear Yearbook" published that, in 2013 alone, 22 trillion pairs of shoes were manufactured worldwide.

Thanks to polyurethane technology, various designs can be obtained, either from moulding as units and their subsequent combination with the body of the shoe, or directly moulded into the shoe.

Polyurethane for shoe soles stands out for its lightness and resistance to abrasion, providing interesting mechanical properties. Polyurethane soles are the result of a reaction between an isocyanate and a polyol system.

Its hardness is imparted by hard segments in the polymer matrix and its density is the result of CO₂ generated by the reaction of the isocyanate and water, as well as by the presence of small amounts of an expanding agent during mixing, as is the case of polyether systems.

Example of polyurethane formation reaction:

Within the footwear sector, polyurethanes are found in a wide range of types. They can be used in shoes and sports boots, business and fashion shoe soles, as well as high quality safety shoes.

Low density to compact polyurethane systems are used for midsoles and outsoles.

Polyurethane type	Hardness	Density
Polyester	Midsoles	280-450 g/l
	Outsoles	900-1100 g/l
	Monosoles	500-600 g/l
Polyether		450 - 600 g/l

The density will depend on the type of sole and its hardness:

PU systems are based on both polyol polyester and polyether technologies. These technologies are suitable for different end uses and mean different processing characteristics.

The systems based on polyester offer greater chemical and abrasion resistance, while polyether systems have a superior resistance to hydrolysis.

Among the differences between the two production techniques is the processing temperature: polyether-based systems are liquid at room temperature, while polyesters require approximately a temperature of 45°C.

Nowadays, polyether and polyester systems are equally valued in the footwear industry, so it is shoe sole producers that make the choice according to their production requirements, being polyester the most used in safety footwear due to its chemical resistance to agents such as oils or solvents. Polyether, on the other hand, is ideal for hydrolysis-resistant soles and to withstand high humidity conditions, such as those found in tropical climates.



Advantages of polyurethane soles:

- Low weight providing thermal and abrasion resistance.
- Flexible soles are produced that enhance the comfort of the user by correctly absorbing the impacts that occur when walking, compared to other materials such as EVA, PVC, nylon or leather.
- Versatility of finishes: Easily customizable with pigments or auxiliary elements.
- Very mouldable material: Polyurethane can be manufactured with different densities to adapt to different types of footwear, whether work or fashion.

In the following chart, the different durability of footwear soles is shown depending on the material they are made of:

A manufacturer of shoe soles usually has a very standardized process and puts its soles through strict quality tests, in which, for example, the parameters in the following table are measured:

Property	Unit
Tension	Mpa
Tear	kN/m
Elongation	%
Flexion	%
Abrasion	Mg

When soles are painted or are to be adhered, the manufacturer usually does a washing or "degreasing" process to remove any remnants of the release agent that may have been left superficially on the sole and that could interfere with adhesion with the paint.

A fairly common process is to insert demoulded soles into an automatic washing machine with a hot perchlorine jet. In this process, the soles are exposed to

perchlorine at 120°C in a rotating tub, over a 10 to 15-minute cycle, to eliminate any grease or dirt impurities that could interfere with the bonding or finishing process.

Current market:

- Asia is responsible for the manufacture of 87% of the world's footwear, with China being the leading country, producing 2 out of 3 pairs that are produced globally.
- However, there is currently a tendency for footwear manufacturers to relocate Chinese production to other areas such as Vietnam, Indonesia and Taiwan.
- In Europe it is more difficult to compete on price and the market is dominated by companies that manufacture specialized footwear, such as safety footwear.
- The same happens in the United States, where the production of military footwear must also be mentioned.

TYPES OF RELEASE AGENTS

The release agents used for the production of polyurethane soles are classified according to the process and material to be demoulded:

- Monodensity or Bidensity soles.
- Polyester or Polyether soles.

Currently the largest consumption is of solvent-based products, although there is increasing interest in the use of water-based release agents, whether ready for use or concentrates to dilute.

Choice should also be made according to the wanted type of finish of the sole: Matte, satin or glossy.

The main properties of a good release agent must be:

- High demoulding power.
- Provide a good finish to the sole in terms of gloss or matte and uniformity.
- Low fouling of moulds and mould holders.



- Versatility for different sole designs.

Release agents for Monodensity soles:

Solvent-based release agents for monodensity soles consist of a dispersion of anti-adhesion agents in an aliphatic or isoparaffin type solvent base.

Lately, chlorinated solvents and the like have been discontinued for toxicological reasons, since they could affect the health of workers.

The concentration of active matter can vary greatly, from 2 to 60%. Being near the highest point the ideal concentration that allows a quick application of the release agent in rotating carousels, good demoulding and surface finish of the sole produced, and at the same time, emitting the least amount of VOC's.

Water-based release agents are an emulsion, that is, they consist of anti-adhesion agents and additives emulsified in water by means of surfactant systems, which can be non-ionic, cationic or anionic in nature.

For this reason they are more critical in terms of transport and storage, being water based, their viscosity can vary depending on temperature, and in no case can they be subjected to temperatures below 0 °C, since this would cause a freezing process that could destabilize the emulsion, breaking it and making it unrecoverable.

A similar effect can occur if the product is subjected to high temperatures (> 50 °C), for example during transport under sunlight in countries with warm or tropical climates.

For their application it is recommended to use an airbrush gun with a 0.3 mm nozzle, as in the case of solvent based ones, but using an air pressure of 2.5 to 3 bars to aid drying.

The temperature of the mould should not be less than 50°C to aid drying, as it is also very important to maintain an application distance of 20 to 30 cm between the gun and the mould, in order to form a uniform film on the surface that makes demoulding easier.

Finally, in the case of water base it is important that between the application of the release agent and the injection / casting of polyurethane a minimum of 1 minute passes, otherwise it may be convenient to use an air gun to speed up the drying and reduce the times of the carousel cycle.

Release agents for bidensity soles:

Bidensity footwear consists of an external polyurethane sole and a midsole, both moulded and joined with one another during the production process. The reason is to ensure that the outer sole has good resistance to abrasion or against oils, and an inner sole that guarantees greater comfort to the user. In this way, comfort and safety are combined in a single sole.

These release agents are widely used for the safety footwear industry, where an impeccable finish and above all a good bond of soles is an indispensable requirement.

Here, solvent-based or water-based release agents are used that contain an active material composed of special non-stick materials that create a homogeneous, stable and consistent film on top of the mould, facilitating demoulding and reducing consumption. These formulations achieve that the residue that remains on the mould after several releases is minimal, thus lengthening the cleaning cycles.

These release agents facilitate the bonding and gluing between two soles that come from two injections of different density, producing soles with a satin finish and little or no greasy feel.

In the case of solvent based, they work perfectly in a wide range of temperatures, and, unlike the release agents for monodensity soles, these are usually formulated with high boiling point solvents as a carrier for the active material, thus obtaining less flammable products and drying a little slower making part of the solvent to act as an oil facilitating the lubrication of the sole in the mould.

In water bases, the factor to be taken into account is that the temperature of the moulds is adequate to facilitate drying, together with a good spray to obtain a good result.

In order to obtain a perfect atomization and distribution of the active ingredients on the mould, as for monodensity soles, it is recommended that they be applied by means of aerographic equipment with a 0.3 mm nozzle.

If their electrostatic version is used, in addition to maintaining the properties of the original product, a saving of 30% in consumption is obtained, as well as the corresponding reduction of VOC's emitted to the atmosphere.



Concentrol

Performance Materials

New factors that are currently taken into account regarding the choice of a release agent:

- Quantity of VOC's and FOG.
- Flammability, with all that entails regulation regarding the facilities where it is used (ATEX), danger according to flash point (Class) and aspects related to transportation and storage.
- Toxicity of the products involved in its formulation and their implications in the work environment, with particular reference to tin compounds and solvents.
- Final impact on the environment.

Reduction of VOC's, TLV's and DNEL:

To completely eliminate direct emission VOC's, the best solution is to change from a solvent-based release agent to a water-based one.

Although this solution is still not very integrated in shoe producers, there is an upward trend to manufacture with water-based release agents, especially if consumption is high and there may be both economic and environmental savings.

Hybrid release agents

Between the solutions based on solvents and those based on water, there is one more option that is known as hybrid demoulders.

Hybrid demoulders or CO-SOLVENT MIX 50:50 demoulders are release agents in which the main material, that is, the carrier of active ingredients, is half water, half solvent (approximately).

In terms of functionality and finishing of the unmoulded part they are like a solvent base, with the main disadvantage that at least half of their formulations contain VOC's.

Even so, it is a good intermediate solution for footwear manufacturers that are currently producing their soles with a solvent-based release agent and do not want to take the step to change to water based due to the inconveniences and change in the way of working that entails.

The change from solvent to hybrid base implies an improvement in certain aspects,

such as price reduction, reduction of VOC's emitted to the atmosphere and better working environment in the production line.

Electrostatic release agents

If the producer of soles or footwear wants to reduce consumption and VOC's without changing the chemical nature of their release agent, electrostatic release agents are a possible solution.

The technical principle under which these types of release agents operate is as follows: Specific electrostatic spray guns are used.

They are connected to a negative pole, while the working mould is connected to a positive pole. When applying a high voltage current, an electrostatic field is generated between the electrode at the tip of the gun and the mould. When the product is atomized, the negatively charged particles move towards the surface of the mould under the influence of the electrostatic field.

The result is that, as opposing loads are attracted, the mould attracts the release agent, efficiently covering its entire surface, avoiding unnecessary losses and thus providing a decrease in consumption.

Any solvent-based release agent can be converted to electrostatic, guaranteeing a solution of sufficient, adjusted and adequate conductivity that meets the needs of the client or the application. Nowadays electrostatic solutions do not present strong odours or additional toxicity, and they allow to work electrostatically with solvents known in the sector as classes I, II or III.

The advantages of the use of electrostatic release agents are, therefore: a significant reduction of the consumption, of 30 to 50%, by avoiding the loss of material that does not enter the mould as a result of the dirtiness of the external parts (mould supports, floors, etc.) and a significant reduction of emitted VOC's, improving the work environment.

The considerations to take into account are the greater difficulty in controlling their application through robotic systems (although manual application is possible) and the need for specific equipment and pistols, larger and heavier than usual, which means greater initial investment in equipment.

Tin-Free release agents:

In recent years both footwear manufacturers and mould release agent



Concentrol

Performance Materials

suppliers have been working to replace organotin compounds with other organometallic compounds, but with some limitations regarding their effectiveness. Most of the organometallic compounds that have been used for a long time are based on tin and include, as the most used, dibutyltin dilaurate (DBTDL).

It is possible to replace DBTDL as a catalyst with other non-organotin substances using specific knowledge acquired in the sector, as well as with strong collaboration and testing with customers, in order to adjust a custom made product that meets all the requirements.

Auxiliary products:

For the footwear market based on polyurethane, there is a range of auxiliary products such as mould cleaners, from the most toxic but effective containing NMP and NEP to cleaners without risk to health and free of NMP.

The specialty chemical company Concentrol has decades of experience in the demoulding industry. A pioneer in its commitment to research and development, Concentrol offers the market tailored solutions for each client using the latest technologies and knowledge of the sector to achieve maximum efficiency and performance. Contact us for more information: marketing@concentrol.com

References:

<http://www.polyurethanes.org>

Huntsman - PU review April 2015



The choice of a footwear release agent

One of Concentrol's strategic divisions is mould release agents, and the release agents for polyurethane footwear soles represents one of our flagship products in this division. The high degree of specialization, thanks to innovation and continuous improvement, has made our products achieve a high reputation and we currently provide service and coverage to a wide variety of industrial sectors. In addition, we are present in all continents with international clients that give us a global strategic vision of the market, making us a reference worldwide.

The choice of the appropriate mould release agent depends on several factors that we detail in this article. The base of the soles with which we work, polyether or polyester, will determine the optimal solution, but we must also take into account the type of sole to be manufactured, which can be of single density or two densities, in which case it requires different injections. The goal of the release agent is always the same: to achieve a high demoulding power, a good gloss or matt finish according to customer requirements, and uniformity of the surface, in addition to achieving the least fouling of the mould and a great adaptability to the pieces defined in the footwear design.

The environmental, safety and health factors are also very important when dealing with release agents for polyurethane soles. Emissions of gases into the atmosphere, toxicity and flammability of the product are important points to consider when choosing a release agent, being the CO-SOLVENT MIX 50:50 or hybrid release agents a solution that manufacturers opt for to reduce the VOC's emitted to the atmosphere and improve the working environment in the production line.

Here we outline all the factors to take into account in the process of choosing a mould release agent for shoe soles.

The importance of mould release agents in polyurethane footwear moulding processes is well known, as it influences in a decisive way the appearance of the demoulded soles, in operations like painting or gluing and in profitability measured in scrap rates.

The most common parameters, that are always considered by a footwear producer,

in order to find the most suitable release agent for his process are:

Mould temperatures: The release agent must be formulated with a carrier that dries fast enough after applying it to the mould, in order to form a good film and release without issues.

The correct mould temperatures are imperative for catalyzing the reaction between polyol and isocyanate at the correct level as the system is formulated, and to get a correctly cured PU shoe sole in a defined cycle time not to disturb productivity targets

The type of Polyol used to produce footwear soles: polyester or polyether.

Polyesters are usually cheaper, and lower in viscosity while Polyether polyols give better abrasion resistance properties, but their viscosity is higher, and they are more expensive.

Release agents are designed specifically for each type of Polyol, meaning that typically a release agent for polyester is not going to release well enough on polyether or would cause pin holes or other undesired effects.

The finish of the footwear sole is also critical in order to choose a correct release agent, because its formulation will be quite different whether a shiny or matt surface is desired. As a general rule, release agents formulated with a high concentration of waxes give more satin/matt finish than the ones that contain just a mixture of silicones and resins.

Later processes like painting and degreasing must also be considered, because normally demoulded soles must be cleaned or degreased before painting them, although some release agents can make this process easier and faster.

Also in **dual density processes** it is important for the release agent to be designed accordingly, in order not to interfere with the bonding of the PU outsole and midsole.

All these factors mentioned above have to be known and studied by the release agent's formulator in order to obtain a product that performs in an excellent way optimizing footwear production lines.



As a quick overview, a release agent is a chemical product, normally liquid, formed mainly by a carrier (water or solvent), that has all the active material and additives dispersed/emulsified in it. Its solid content can differ from some release agents to others, as we can have ready-to-use low-solid-content ones, usually formulated with a fast evaporating solvent, like heptane, or concentrated ready-to-use release agents with higher solid content in order to apply a lower flow rate with the spraying equipment, and generally formulated with a lower volatile solvent, for example C9-C10 naphtha, which also will take longer to dry.

However, when choosing a release agent there are other factors, apart from the ones mentioned above, that have to be taken into consideration and are also important:

All these factors intervene in the choice of a release agent and need to be taken into account for the optimal operation of the line, as well as its incidence in a balance between safety, environmental & workers protection with cost levels, to maximize productivity while producing high-quality footwear items.

VOC's

The European Union defines a Volatile Organic Compound (VOC) as "any organic compound having an initial boiling point less than or equal to 250 °C (482 °F) measured at a standard atmospheric pressure of 101.3 kPa."

They are considered one of the most spread out pollutants in the atmosphere, because they are key substances to understand the troposphere ozone formation together with nitrogen oxides.

Related to release agents, there are some VOC's produced during polyurethane manufacture (stack emissions & direct emissions) and there are several ways that they can be reduced with release agent's technology.

The typical solvents used in release agents are aliphatic or isoparaffinic hydrocarbons.

Reduction of VOC's:

The first step (and the easiest one) to reduce VOC's is to change from a low solid content ready to use release agent to a concentrated ready to use one.

Concentrated release agents have advantages compared to low solid content ones, the main advantage is that the flow rate of the product applied on to the mould is reduced, while also the overspray. This allows us to optimize the production and the reduction of the cleaning cycles inside the moulds and around them. Providing also a better working environment with less solvent in the atmosphere.

However, to completely eliminate VOC's the best solution is to change from a solvent based release agent to water based one.

Water based release agents, in some families of polyurethane foam, have been readily available for many years but their main disadvantage during past years was that they give a greasy finish to the demolded polyurethane item, not acceptable for many manufactures.

Improving this parameter without losing release capacity has been one of the most difficult challenges of the last several years.

The trends in the markets is to work constantly on this subject, improving water based and co-solvent release agents, making them more dry-finish & solvent based looking, while keeping their great release capacity and making it possible to glue and paint on them.

Between solvent based and water based there is an intermediate solution: Co-solvent 50:50 (hybrids)

The CO-SOLVENT MIX 50:50 are release agents in which the main material, that is the carrier of the active ingredients, is half water half solvent (approximately).

In terms of functionality and finishing of the demoulded part, they are like solvent based, with the main disadvantage that at least half of their formulations contain VOC's.

Even so, it is a good intermediate solution for footwear manufacturers that are currently producing their soles with a solvent based release agent and do not want to take the step to change to water based on the inconveniences and change in working methods that entails.

The change from solvent based to hybrid means an improvement in certain aspects, such as price reduction, reduction of VOC's emitted to the atmosphere and better working environment at the production line.



Concentrol

Performance Materials

Aside from water based release agents and co-solvents, another solution to reduce VOC's in the application stage of the release agent is the use of Electrostatic Release Agents.

Application systems

- Application robots

Basically almost all release agents can be applied manually by spray gun or automatically by robot. The main purpose to use a robot is for cost savings. Nowadays robots can apply in all axes, assuring the correct application of the release agent, as well as a human operator would do.

Benefits:

- Always the same application, it limits the risk of delamination in dual density shoe soles due to excessive application due to human error.
- Optimization of the release agent consumption, which means longer cleaning cycles and extends mould's operating life.
- Easy to work electrostatic application by robot rather than by hand.
- The application speed can be increased/adjusted without risk of fatigue.
- Cost reduction.
- More homogeneous production, as the same amount of release agents, on the same areas of the mould, is consistently applied.

Disadvantages:

- Robots can certainly handle their set tasks, but they typically cannot handle unexpected situations, quite common in the PU industry, such as when there are some problems in a specific mould.
- Higher initial investment.
- Robots installed in workplaces still require manual labour around them. Training those employees on how to work with robots definitely has a cost attached to it.

Regarding the application technology on release agents, we must consider also electrostatic technology, which works together with electrostatic release agents. Any solvent-based release agent can be

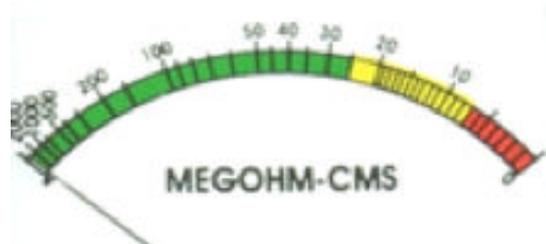
converted to electrostatic, guaranteeing a sufficient, adjusted and adequate conductivity solution that satisfies the needs of the customer or the application.

Nowadays, electrostatic solutions do not present strong odours or additional toxicity, and they allow us to work electrostatically with solvents known in the sector as classes I, II or III. The advantages of using electrostatic release agents are, therefore, a significant reduction of consumption, of between 30 and 50%, by avoiding the loss of material that does not go into the mould as a result of dirt from external parts (mould holders, floors, etc.) and a significant reduction of VOCs emitted, improving the work environment.

The considerations to be taken into account are the greater ease of controlling their application through robotic systems (although manual application is possible) and the need for specific equipment and guns, larger and heavier than usual, which means greater initial investment in equipment.

As it is shown in the comparison graph, with electrostatic release agents a 30-50% reduction of the flow rate applied can be achieved, this means that also VOC's are being reduced this percentage. Also a lower impact on environment and an improvement in the workplace are achieved.

All Concentrol's solvent based release agents can be adjusted to be used with electrostatic equipment according to an electrical resistance value proposed by the customer, together with the equipment supplier, that is usually around 200-500 MΩ.



Flammability

During the use of release agents, mainly solvent based ones, also ATEX (Explosive Atmosphere) has to be considered, although for a potentially explosive atmosphere there must be a combination of a flammable or combustible substance with an oxidant at a given concentration and together with a source of ignition. The risk becomes greater



Concentrol

Performance Materials

and more complex when we are in a confined space and with manipulation of these substances.

To avoid having to install ATEX facilities, there is only the solution of using water based release agents, although regarding different flammability grades (known in the sector's jargon as Class I, Class II & Class III), other solutions can be implemented, like concentrated class III release agent, electrostatic release agent, wax pastes...

However, despite having ATEX installation, there are advantages to some kind of solvent release agents compared with others.

In the polyurethane sector there is an old known classification of solvents that are part of the release agent as carriers of the active ingredients:

- Class I: Easily flammable: Substances whose flash Point is below 21°C.
- Class II: Flammable: Substances whose Flash Point is between 21°C and 55°C.
- Class III: Combustible. Substances whose Flash Point is over 55°C.

Hazards and environmental impact

In addition to the flammability, the hazards of the products involved in the formulation of the release agent, and their implications in the work environment, may come from tin compounds. To avoid the use of these restricted substances, a new variant of mold release agents has been extended worldwide, the release agents without tin.

Release agent's suppliers have been working in the past years to substitute organotin compounds with other organometallic compounds, mainly based of Bismuth or Zinc, but with some limitations to their effectivity.

Also, amine-catalysts have been studied as alternatives, but while amine catalysts exert some effect on the isocyanate-hydroxyl reaction, organometallic salts favour the isocyanate-hydroxyl reaction almost exclusively and are thus gelation catalysts. This means that metal-based catalysts typically accelerate the gelling reaction between the isocyanate and the alcohol, whereas amine-based catalysts are mostly

used in foaming reactions as these catalysts also promote the isocyanate-water reaction. Most organometallic compounds used for a long time are based on tin and include stannous octoate, dibutyltin dilaurate (DBTDL) and tin mercaptides. Certain salts of lead, mercury and antimony have also been used.

Tin compounds, especially dibutyltin dilaurate, are in widespread use in coatings as catalysts for the isocyanate/hydroxyl reaction. As a general rule, organotin catalysts are not selective, they catalyze the reaction of isocyanates with both hydroxyl groups and water, and also catalyze the hydrolysis of ester groups.

The catalytic effect of metal salts is more complex than that of amine, which compounds with either hydroxyl or isocyanate. Tin and other metal catalysts activate both polyol and isocyanate, first by the formation of a binary complex between the catalyst and polyol and then by the joining of the isocyanate.

Substituting DBTDL as catalyst with other non-organotin substances is possible using state-of-art knowledge together with strong collaboration and trials with customers, in order to refine tailor-made products that meet all requirements.

SUMMARY

CONCENTROL, with its range of release agents, is constantly working in all the points described above to improve its products and offer a solution, together with improvements on customer's lines, like new equipment or changes in their processes. Each PU footwear line must be studied individually in order to recommend the most suitable release agent, spray gun, and other equipment facilities.

This article was intended to inform of different factors which should be taken into account, besides its obvious function, when choosing a release agent for footwear polyurethane, and also showing some of the solutions that CONCENTROL offers to its customers in order to achieve all their targets.



Water based release agents for phylon

In recent years the footwear industry has been growing at a constant pace thanks to the high demand for an aesthetic product, in accordance with fashion, and, even so, highly comfortable and durable. The footwear industry can be classified by the type of user, purpose of the footwear, and among other parameters, the material with which it is manufactured.

In this article we will focus on the footwear material known as phylon, a modification of EVA rubber, which by means of a thermoforming and cooling process achieves a less dense material, and, therefore, lighter.

Before going into more detail about phylon, we will focus on EVA rubber to learn about the origin of this new material that is expanding.

EVA rubber is a copolymer formed by the repetition of ethylene and vinyl acetate monomers. The proportion used of these two components will determine the properties and qualities of the material. Generally between 10% and 40% vinyl acetate is used, and the rest is ethylene. The higher the percentage of vinyl acetate, the higher the quality of EVA rubber, since with a small percentage a hard and brittle polymer would be obtained. EVA is a soft plastic that, thanks to its foaming process, is perfect for use as a shoe sole.

The foaming of EVA is done by introducing gas into the polymer. A foaming agent, azodicarboamide being the most common, is introduced into EVA mixture. This, when the mixture is heated, decomposes producing gas that is trapped in the plastic. The gas expands and EVA foam forms. Once EVA foam is formed, shoe soles or other parts of the shoe can be formed through different methods. One of them, the hot compression process of EVA foam, results in phylon.

Phylon is the most common process for creating soles for sports shoes. This process starts with EVA already expanded, that is, with EVA foam, which contains gas bubbles inside. This foam is introduced into a mould with the design and final shape that the sole will have. The mould closes and it is heated, melting EVA inside allowing the trapped gas to expand further, making it easier for EVA to fill the mould. The mould is cooled and the EVA part is extracted.

The extraction of the phylon part is carried out thanks to the presence of a release agent. This agent is applied by spray gun or brush, providing the necessary lubrication to be able to extract the part without causing superficial damage. In addition, these products are responsible for the appearance and surface feel of the demoulded part.

Concentrol's demoulding department has developed a concentrated product to dilute in water for this process. The product **CONCENTROL LP IADC-114-43 PHB** can be diluted up to 1:100, depending on the working conditions, maintaining a high demoulding efficiency and its stability at temperatures over 200°C.

CONCENTROL LP IADC-114-43 PHB gives parts a glossy finish (figure 1), but with the addition of a Concentrol matting agent, it is possible to achieve a satin or even matte shade (figure 2).



Figure 1: CONCENTROL LP IADC-114-43 PHB (original)

Figure 2: CONCENTROL LP IADC-114-43 PHB (Concentrol matting agent)



Success Story - Footwear Sector

What have we achieved?

Concentrol is going through an internationalization phase. Through our trade network, we want to offer our chemical solutions to all the customers that need them, offering the best technical and customer support for each case, which we always treat in a personalized way. This is the case of a Mexican customer, who was looking for a specific solution for the manufacture of their product.

The protagonist of this success story is an international customer who designs and manufactures soles of shoes. Their need is to improve the production process. Their problem was that the molds they used got really dirty, the soles got stuck and the result they achieved was not uniform.

The large growth of the business and its premise of prioritizing quality above all could not allow the imperfections of their products. That is why this family-owned company leader in the sector requests Concentrol a tailor-made product that allows them to optimize and improve the manufacturing process.

This customer wanted to maintain the manufacture of soles with polyurethane, with the aim of prioritizing quality and better solidity results. The soles manufactured by the customer are complex and with demanding finish and quality.

After analyzing the situation, Concentrol present to the company a custom solution. Based on a product line that improves performance, we adapt a formula that achieves a less dirty mold (more than twice the effectiveness of the product they used previously), with the added bonus of achieving more uniformity and a better-performing painting and more uniform result.

How we did it

We designed a customized product, based on a solvent-based product that is versatile and with many possibilities. Bear in mind that we are dealing with a high-end product by Concentrol.

The new composition of the original product has achieved very good results to solve the impediments that the customer faced. With regard to the dirtying of the molds and the imperfections that this caused, with the new product application production was improved so that while the molds had to be washed three times a week, now they only need be washed once. This has also led to a reduction in costs, since production need not be stopped as much as before. The quality of the result has also benefited.

As for the painting process, the customer now gets better results in less time, which also implies a substantial optimization. In addition, we have managed to reduce the scrub that the customer had during the manufacture, because the product that we have offered reduces this problem thanks to its properties.

Our solution

Consistency, quality and treatment and highly personalized services have been the keys to this recent success story.

At Concentrol we prioritize quality and focus on excellence. When we find a customer that works in our line, in this case a leading manufacturer in expansion, we work to be able to respond to their needs. We know that positive experiences that result in successful products benefit us in a qualitative way and this makes our company grow permanently.

That is why the company is committed to invest more and more in R + D to offer new chemical solutions, adapted to market trends and specific for each sector. Innovation is a fundamental part of Concentrol's DNA, as well as the commitment to meet new challenges to improve every day.



Concentrol

Performance Materials

Footwear sector: Concentrol's water-based mold release agents, for single and dual density soles

At Concentrol, we work day after day on the constant improvement of production processes and internal operations. All these activities not only allow us to reduce costs, but also give us the possibility of finding solutions that are increasingly sustainable, **respectful with the natural environment and with the work environment and workers.**

The company has in its catalogue a wide range of products for the manufacture of all types of polyurethane footwear: **mold release agents, stabilizers, cleaners and adhesives.** Especially, we stand out in the making of solutions for polyurethane footwear, with an increasing demand in the current market of the sector.

After dedicating time and resources in researching new solutions for polyurethane footwear, more sensitive to the environment and production personnel, we developed **water-based release agents for footwear and polyurethane soles (DSM), both single-density and double-density.**

Water-based mold release agents are **sustainable** and environmentally friendly products, thanks to **lower flammability** and a reduction in harmful properties and emissions of volatile organic compounds. Therefore, we could say that they have a capacity to regulate emissions (they emit lower levels of VOCs).

WATER-BASED MOLD RELEASE AGENTS FOR SINGLE DENSITY SOLES

Firstly, we present the water-based mold release agents aimed at the manufacture of **single density polyurethane soles** for footwear, both for polyester and polyether.

This Concentrol range has multiple **benefits**, both with regard to the appearance, the finish and the customization of the pieces; as well as what affects the sustainability of the product:

- Homogeneous appearance without defects
- Development of customized products
- Longer cleaning cycles
- Control of the piece finish

Water-based release agents for single density soles have the following **properties**:

- High mold release power
- Minimal mold fouling

- Wide operating temperature range
- Compatible with our additives for gloss control
- Compatible with subsequent painting processes, with or without degreasing
- Tin-free formulation option
- RSL studies on demand (Restricted Substances List)
- Availability of environmentally friendly cleaners

WATER-BASED MOLD RELEASE AGENTS FOR DUAL DENSITY SOLES

At Concentrol we have also specialized in the development of sustainable solutions for polyurethane footwear with **dual density soles.** As we have already seen with DSMs for single-density soles, the nature of the release agent allows for a series of **benefits**:

- Homogeneous appearance without defects
- Development of customized products
- Longer cleaning cycles
- Control of the piece finish

Regarding the properties of the product, unlike water-based release agents for single density soles, these release agents adapt to the characteristics of dual density soles, **ensuring perfect adherence between the layers.** Among their **properties**, we find:

- High mold release power
- Minimal mold fouling
- Wide operating temperature range
- Ensures perfect adhesion between layers
- Compatible with our additives for gloss control
- Compatible with subsequent painting processes, with or without degreasing
- Tin-free formulation option
- Availability of environmentally friendly cleaners

At the end of this article, two infographics have been prepared that visually explain the properties and benefits of water-based mold release agents applied to polyurethane footwear.



Concentrol
Performance Materials

OTHER CONCENTROL RANGES OF POLYURETHANE FOOTWEAR MOLD RELEASE AGENTS

The water-based release agents for PU footwear are solutions that we have developed in response to the climatic emergency. It is the most sustainable range of release agents and, moreover, more careful with the work environment. In addition, at Concentrol we also have other intermediate solutions for those clients who still cannot take the step.

In our catalogue we have other options, such as **solvent-based mold release agents and hybrid or co-solvent mold release agents (50% solvent-based, 50% water-based)**. In addition, in each one of them we adapt to the requirements and needs of the clients, also offering concentrated products, tin-free or suitable for electrostatic applications.

At Concentrol we work to devise and produce solutions that are fully adapted to the needs of our clients, taking into account our commitment to society and the world in which we live.

We are currently present in many countries, most of which are leaders in this sector such as China, India, Vietnam, Indonesia, Brazil, Turkey, Pakistan, Mexico, Italy, United States, Thailand, Russia, United Kingdom, Netherlands, Belgium, Morocco, Spain and Portugal, among others.

Sustainability is a primary matter for the protection of three fundamental pillars: caring for the environment, social development and economic growth. For this reason, we have invested resources (and will continue to do so) in developing efficient solutions for our clients, while ensuring the safety of our team and the protection of the planet.

For more information, you can contact us and we will be happy to present you the options that best suit your needs.

If you are interested in obtaining more information on release agents for the footwear industry, contact us at Concentrol or via the e-mail:

ydezabala@concentrol.com

