COST-EFFICIENT FOR A HIGH QUALITY AND SAFE LAMINATED GLASS PRODUCT

LiSEC

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Prelude

The safety standards in the glass industry are also being raised constantly. This is one of the reasons why laminating is increasingly gaining in importance. However, this complex process involves a number of challenges and stumbling blocks that should be known in detail when producing high-quality glass laminate products.

The pre-laminate is considered the heart of a laminating system because this is where the majority of the process takes place – it is here that the foil is heated and pressed or bonded to the glass with rollers and the enclosed air is pressed out of the glass package.

Due to the growing supplier density on the market, which is also becoming increasing transparent, cost-efficient production is an absolute must because this is the only way to gain a certain competitive advantage over the competition. On the pages that follow, you will discover how the professional and correct laminating process should be carried out.

CHAPTER 1

Chapter Overview

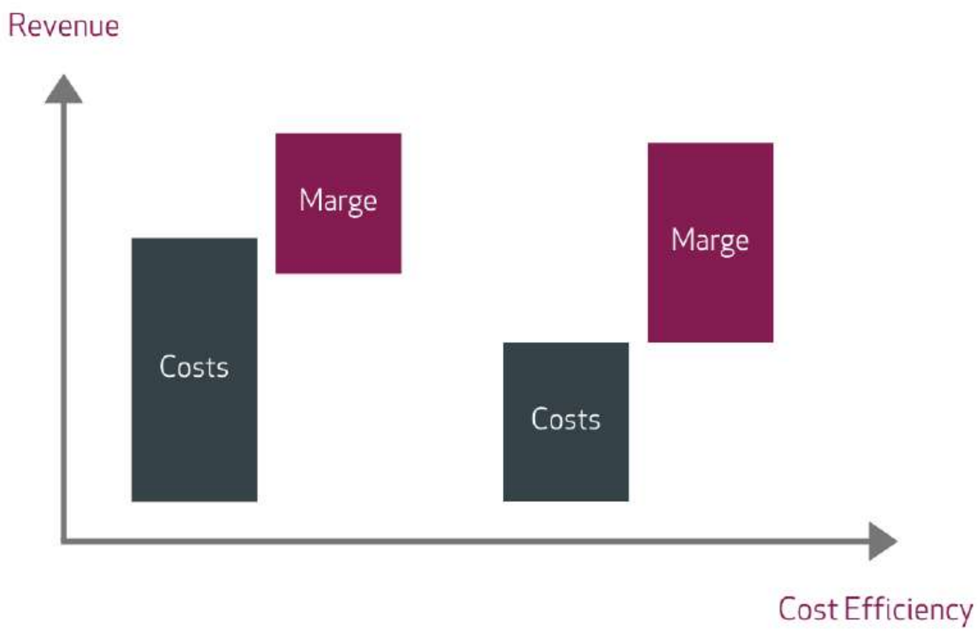
In Chapter 1, we demonstrate how to realise the lamination of glass products as cost-efficiently as possible. This is essential, in particular given the rapidly growing levels of competition in the glass industry.

The four most important points for increasing performance are:

1. Machine concept
2. Foil placement, foil cutting
3. Aligning the glass
4. Pre-lamination

Cost effectiveness with laminating products – what you need to consider!

During times when the number of suppliers in all industries – and naturally also the glass industry – is steadily increasing and the market is becoming more and more transparent at the same time, the importance of cost-effective production for higher profit margins is increasing tremendously. Furthermore, individual representatives of the glass industry can gain a certain competitive edge over the competition in this way and develop it accordingly.



But also in terms of cost effectiveness, it is important to take a holistic view of the production processes and analyse them in detail. In the case of lamination systems, the speed of pre-lamination should by no means be regarded as the only way of improving cost effectiveness with this procedure.

After a detailed analysis of all parameters, it quickly becomes clear that many measures relating to the machine and the control system have a significant influence on efficient production.

MACHINE CONCEPT

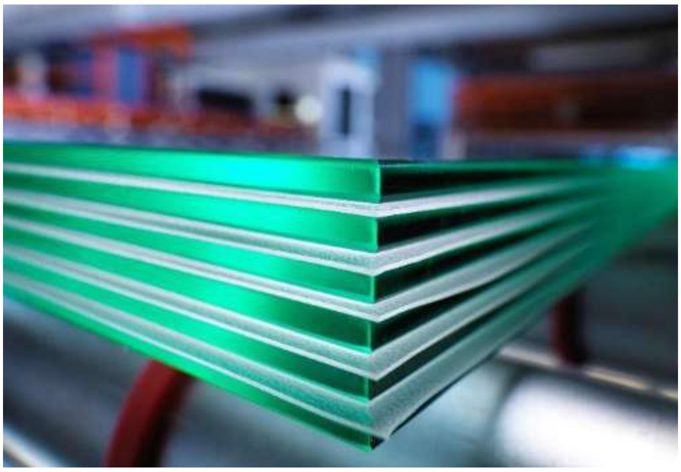
Cost effectiveness starts with the planning of your own company and by determining the development steps for the future.

The following seven questions are crucial here:

1. Which glass products do you want to manufacture?
2. What is the planned utilization?
3. How do you want to develop?
4. Which market segments do you want to develop or open up?
5. Current and future proportion of glass sizes and glass quantities?
6. Planned return on investment
7. (Planned) cost of products

Points 5 to 7 in particular can be regarded as key questions. But it is only when all of these questions have been answered that the entrepreneurial direction will emerge. And only then can you make an informed decision about which lamination systems (width, performance and degree of automation) are the correct ones for your own operation.

The machine width is considerably dependent upon the glass size that a company wants to produce, and has a strong influence on the amount of the investment.



Here is a practical example:

Customer XY only wants one lamination system in production. Their company mainly processes sheets that do not exceed a width of 2.6 metres (92%) in 3-shift operation. However, the customer requires glass sheets with a width of approximately 2.6-3.0 metres for special productions (8%).

Following a detailed analysis of their business plan and the future direction of their company, they decide on a lamination system that is narrower than 2.6 meters for process and cost reasons. And so they are absolutely right in this example. Because the wider system would also have increased the cost of any spare parts, such as rollers, and the level of complexity in terms of foil placement and cutting. This would also increase the investment costs.

Furthermore, the amount of foil wastage in wider systems also increases if the number of foil rolls in the magazine is not increased.

The customer can buy the bigger sheets for the 8% special production, since the proportion in this example is very low. Large companies that use multiple lamination systems also work according to this principle in many cases in order to increase efficiency and reduce production costs. This approach is heavily dependent upon the customer segment and the products required in this segment. In such companies, the laminated glass products are sorted in advance and assigned to the appropriate lamination system in order to ensure that the process is quick and efficient.

FOIL PLACEMENT / FOIL CUTTING

There are also different types of foils that are used to bond glass lites sheets together, depending on their composition, degree of moisture and thickness. Special soundproofing foils are very different from those that have been developed for bulletproof glass, for example, even if the basic functionality is the same. And these differences also have a significant impact on the price per square metre.

For this reason, the foil itself also has a significant influence on the total production costs. Whereas a standard PVB foil costs around 4 euros per m², special foils can cost 4 or 5 times as much.

In terms of cost effectiveness, it is therefore of fundamental importance to place the foil economically and efficiently and to keep the foil overhang as small as possible so that foil wastage can be reduced. If a small glass with a width of 1 m is produced on a lamination system with a foil roll width of 2.6 m, for example, more foil wastage will occur. Wrinkle-free intermediate storage (for example with a foil shuttle) is also essential for this, so that the foil can be reused at a later point in time and overall costs / foil wastage are significantly reduced.

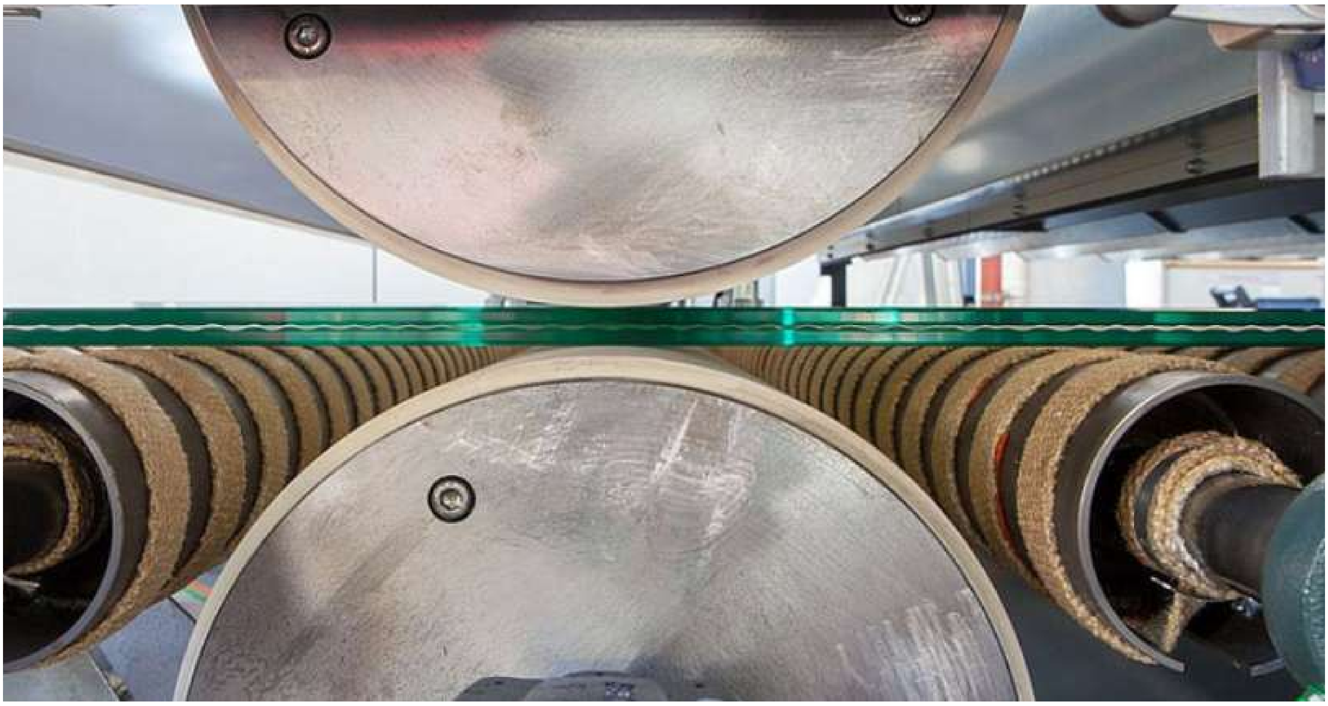
GLASS ALIGNMENT

Glass alignment is the real “bottleneck” of a lamination system. The converter places the aligned glass onto the first glass and the foil. The availability of the glass sheets is particularly important when it comes to production speed with this process.

However, the cycle time can only be improved with an optimal combination of design with regard to glass alignment and positioning accuracy, and stable automation and programming.

PRE-LAMINATION

Another very important element with regard to efficiency is pre-lamination, which is the final link in the process chain and is often referred to as the heart of a lamination system. Pre-lamination has a significant influence on the quality of the finished laminate. However, in addition to the pre-lamination speed, the upstream process steps of glass alignment, foil placement and cutting must also intertwine in the best possible way to achieve optimal results.



PRE-LAMINATION SPEED

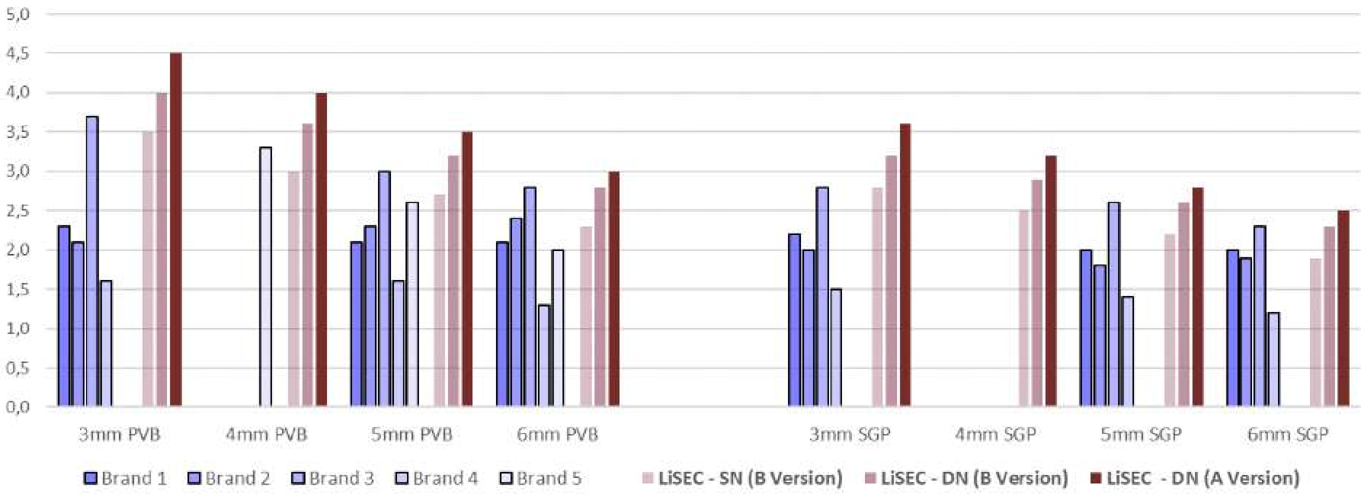
The speed mainly depends on the energy supply, but also on the reproduction of the energy. Energy that is extracted from the laminated glass packages during pre-lamination must be recycled as quickly as possible in order to ensure efficient production. Otherwise the cycle time is reduced because the foil cannot warm up quickly enough due to an insufficient quantity of ambient energy.

There are two approaches with regard to this:

- Radiation – Energiezuführung durch IR-Strahler
- Konvektion – Energiezuführung durch Luft

It has been shown in practice that a combination of both approaches is the most effective. With low-E glass, the radiation (heating energy) is very strongly reflected by the coating. This means that the foil takes more time to reach the right temperature. This effect can be compensated for to a considerable extent by means of convection.

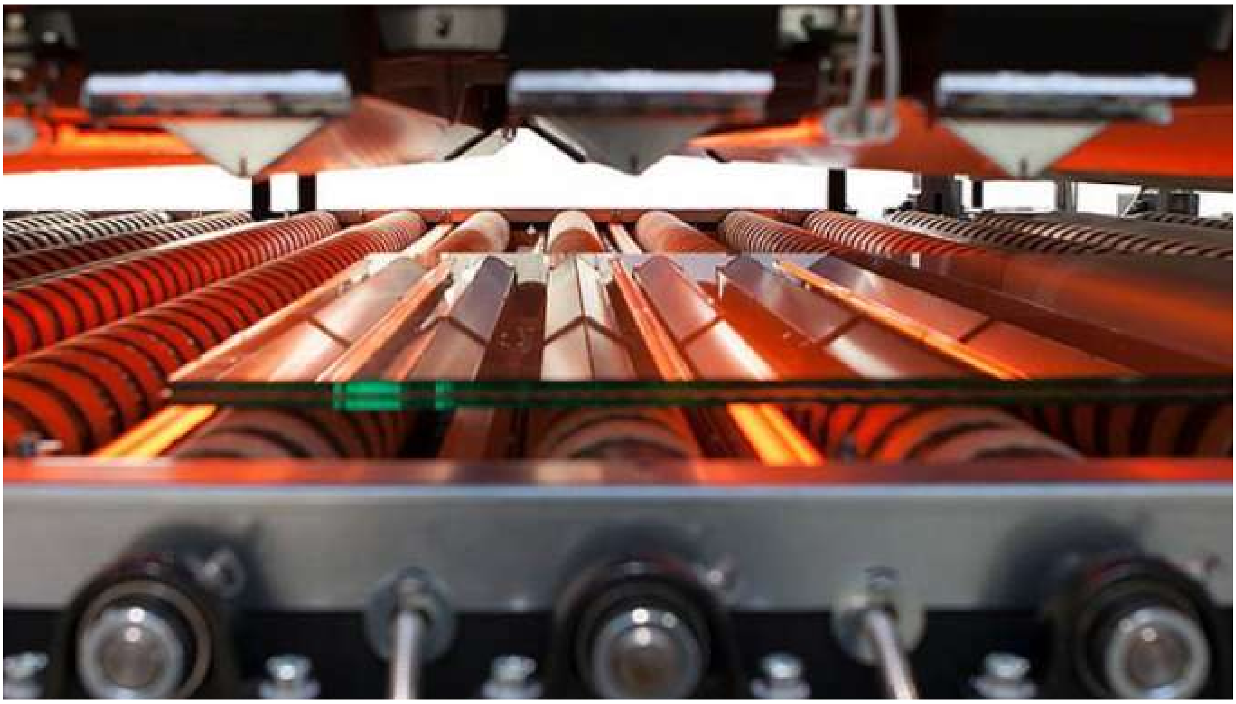
However, with clear glass, which represents the majority of laminating glass, energy-efficient IR radiation is required to speed up the heating of the foil. The use of radiation or convection alone therefore not only weakens the energy transfer into or through the glass, but also the supply of energy for the next laminated glass package.



The figure shows the speeds of different lamination systems. Here it is clearly evident that LiSEC not only has 3 different pre-lamination machines to choose from, but can also score points in terms of speed.

In addition to speed, the waste that can arise in pre-lamination also plays a significant role when it comes to increasing cost effectiveness. This particularly applies to the processing of expensive foils or with expensive glass lites sheets with printing as well as tempered glass lites sheets.

Experience has shown that pre-lamination with a spindle drive for the pressing roller infeed leads to significantly greater stability and process reliability and significantly reduces waste resulting from having an edge seal that is not optimal.



CONCLUSION:

Pre-lamination can be described as the “heart” of a lamination system. But when it comes to increasing efficiency, there are many factors to consider. Only after a detailed analysis of all parameters should the decision be made as to which lamination system is right for your own operation. But the foils themselves, as well as the processes of foil placement and cutting and glass alignment, also have a fundamental influence on the overall cost effectiveness of the lamination process.

CHAPTER 2

Chapter Overview

Quality naturally also plays a central role in the lamination of glass products – and not only due to the respective customer requirements, but also the safety standards, which are constantly being expanded and developed. Smooth operation of the entire lamination process is the prerequisite for faultless quality of the end products. This chapter explains exactly how this is achieved.

The following important aspects will be addressed:

1. Pre-lamination
2. The autoclave process

This is how you can recognise a high quality and safe glass laminate product

Safety standards are constantly rising in all possible areas in which glass is used or installed – which is the reason why lamination is also becoming increasingly important in the glass industry. However, due to the complexity of this process, it is crucial to know all about the challenges and stumbling blocks that arise in order to act or react respectively.

This is the only way to ensure that the lamination process is smooth and stable, which in turn is a prerequisite for top quality and optimum end products.

In conjunction with excellent pre-lamination, this expertise also helps to reduce production costs, since process time and glass waste can be significantly reduced in this way. This particularly applies when complex foils or tempered glass are being used. Any defects that have occurred during lamination are clear to see after the first pressing of the glass in the pre-lamination or after the autoclave process.

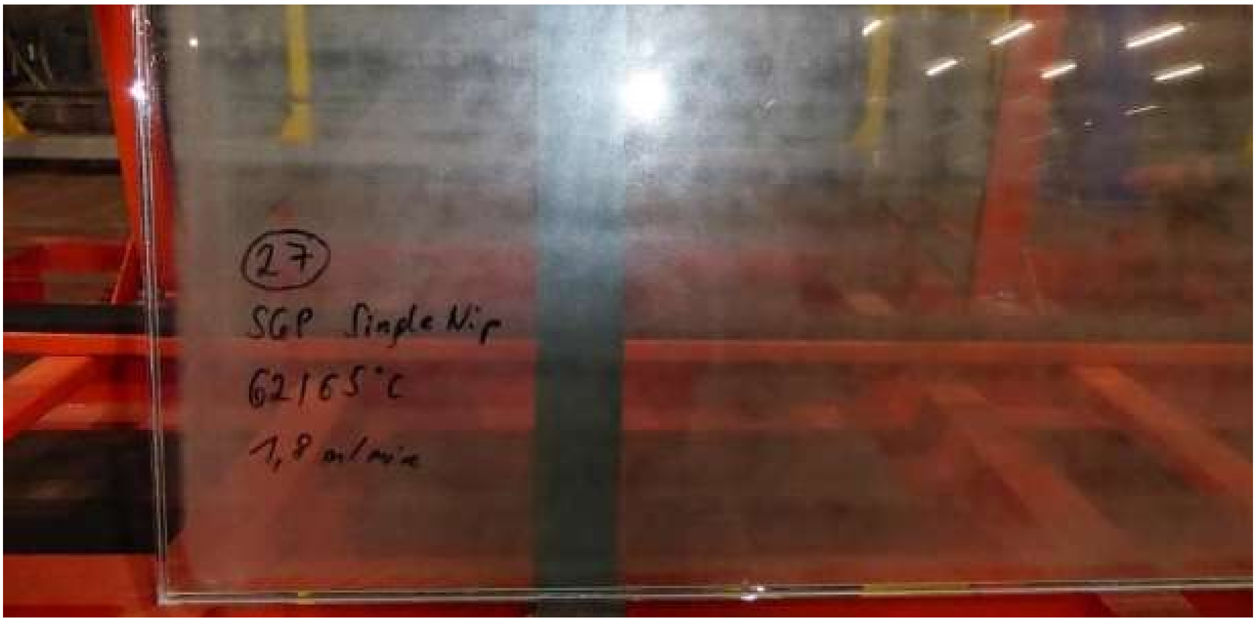
With tempered glass, glass evenness is an important prerequisite for a high-quality glass laminate product. Due to the high temperature (over 600°C) and the ceramic transport rollers used, traditional tempering technology with roller furnaces can lead to so-called roller waves and other deformations in the glass, which can complicate the laminating process. Therefore, the glass must at least comply with the standards EN 12150-1 for ESG and EN 1863-1 for TVG. In order to ultimately achieve good quality and a stable process, an even better glass quality is recommended. The better the evenness of the tempered glass lites sheets, the thinner the foils that can be used. Furthermore, the lamination process is also stabilised and delamination is prevented, which additionally reduces production costs and therefore also the product costs.

Attention must be paid to the following points following the pre-lamination process:

- Edge seal
- Pressing force
- Pressed too cold
- Pressed too warm
- Glass offset

EDGE SEAL

A good edge seal is recognisable from the fact that the edge area of the laminated glass is transparent over a width of around 20 mm. This is a clear indication that the foil and glass are optimally bonded together.

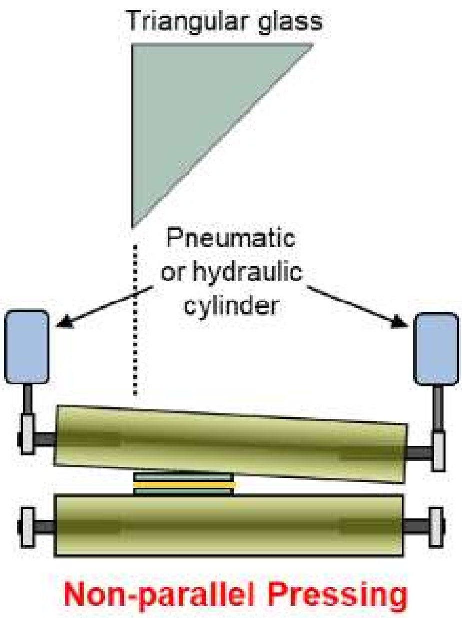


On the other hand, the foil structure is still visible in the remainder of the laminate. It should appear even across the entire area. This shows that the pressing force of the pressing rollers and heating by means of convection or radiant heaters were always good and even during lamination.

PRESSING FORCE

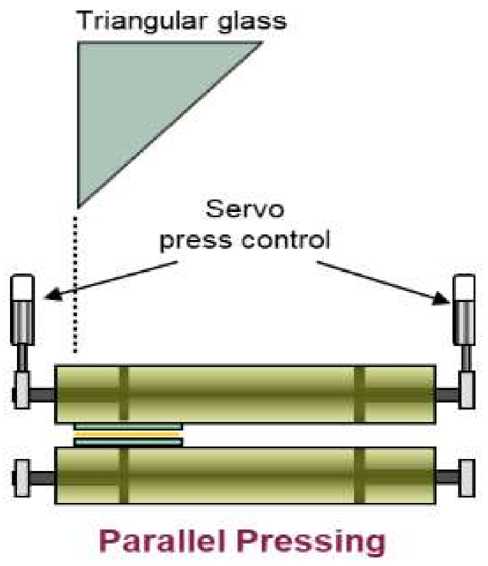
Two main technologies are used in pre-lamination to exert pressure with the pressing rollers:

- the hydraulic or pneumatic application of pressure using cylinders
- the spindle technology



The hydraulic or pneumatic application of pressing force using cylinders is simpler from a design point of view and therefore more cost-effective, but involves numerous challenges. And if rectangular glass sheets are not being used, but rather diamonds or triangles which are gaining in popularity in architecture, for example, the complexity increases again significantly with this technology. Quick and precisely timed pressure changes are also only possible to a limited extent. However, these are needed to create an optimal edge seal, particularly for large glass cutouts in the laminate.

The glass product also always has to be pressed in the middle of the pre-lamination with this technology, otherwise parallel pressing using a cylinder cannot be guaranteed. The result can be an uneven edge seal or uneven laminate thickness, which in turn can complicate further processing and reduce the cycle time. As a result, permanent readjustments of the press are required, which may not only significantly increase glass waste, but also the costs.



Spindle technology is used much less often, which is probably because it is the more cost-intensive technology. Nevertheless, it has several advantages. Working with spindle technology is more sustainable and eliminates the above-mentioned problems. This particularly applies to the production of special glass lites sheets in the architectural area, where the pressing process can be carried out very efficiently, resulting in highest quality and therefore also lower product costs due to less wastage.

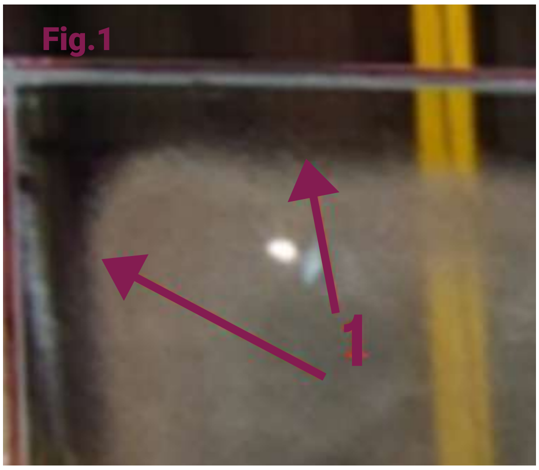
This technology can also be adjusted at the push of a button, and the spindle is considerably more stable with regard to service life and process reliability. Furthermore, production can be carried out and continuously monitored due to the even pressure distribution on a reference side, which significantly simplifies the entire process. A stable process and high product quality are also ensured here if production is not permanently carried out exactly in the centre of the system. If a servo spindle is used, very quick and precise pressing force adjustment is possible on the one hand, and on the other hand parallel pressing is possible thanks to the interlocking drive.

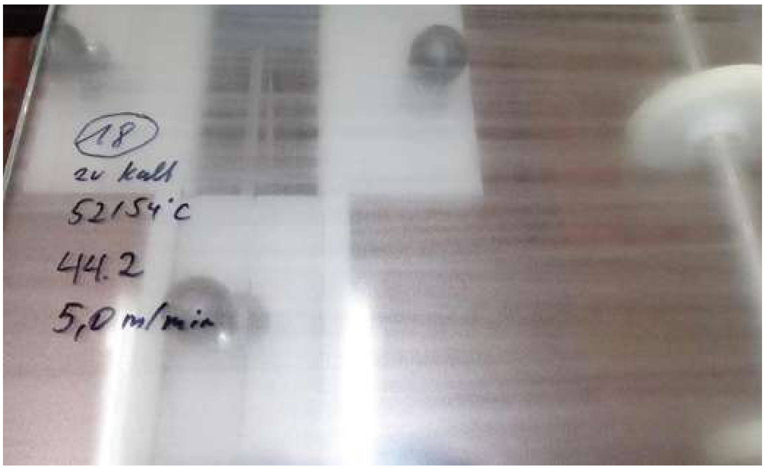
If the pressing force is incorrectly adjusted, the air bubbles between the glass and the foil are not squeezed out and the edge seal is insufficient. This phenomenon is already evident after the pre-lamination process, and can even lead to complete delamination in the autoclave process in extreme cases.

In the example shown here, pressing was first carried out with the correct force, and then with virtually no pressing force. After the pre-lamination, the glass product can appear as follows:

PRESSED TOO COLD

If too little energy is introduced before the pressing process - i.e. if the pressing is too cold - the transparent 20 mm (see Figure 1) at the edge of the laminated glass, which is visible if you have an optimal result, disappears. And this is a clear indication that the adhesion between the foil and glass is insufficient. Following the autoclave process this can lead to numerous problems, such as the so-called "blow-in" phenomenon(see page 16).



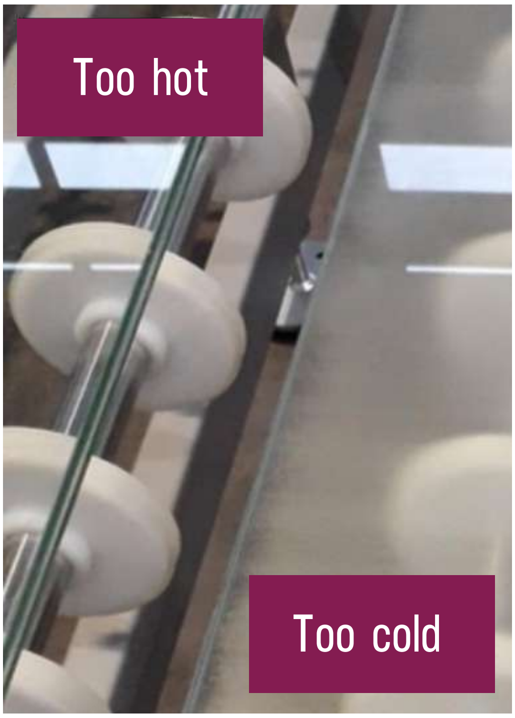


PRESSED TOO HOT

However, too much energy is also not optimal. In this case the laminate is pressed too warm. This makes the foil too soft and sticky, which can be recognised from the fact that the glass package is almost transparent. The foil adheres too strongly to the glass before venting using a pressing roller, which means that the residual air cannot not be properly pressed out of the laminate.

This residual air expands in the autoclave or additional air is pressed into the laminate due to the lack of foil adhesion to the glass and the 12 bar of overpressure. This creates many circular bubbles, and the glass package does not appear transparent as it should.

Here again, the direct comparison of too cold vs. too hot:



The following phenomena can occur after the autoclave process:

Following the pre-lamination process, the laminated glass packages are fully pressed in the autoclave with a defined pressure and at high temperatures for a certain time.

The following quality problems can occur from this:

- Blow-in
- Air trapped
- Offset
- Autoclave cooling problems
- Bubble formation due to incorrect hold time
- Mineral and organic impurities

BLOW-IN

So-called blow-in occurs if the recipe in the autoclave has not been correctly set - for example, if the pressure is increased too quickly and therefore air is pressed back into the laminate. This can also happen if there is no proper edge seal.

This example shows how important it is to have a good edge seal.

AIR TRAPPED

Air trapped means that not all of the air has been pressed out of a laminated glass package.

This quality problem can arise due to the following factors:

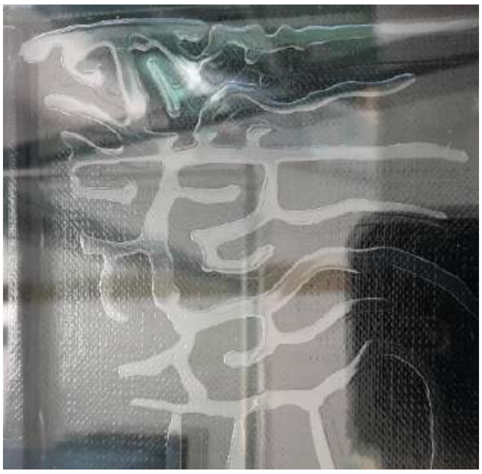
- Pre-lamination pressing not optimal
- Too hot in pre-lamination (foil too sticky)
- Roller wave with tempered glass
- Humidity too high

If too much heat is applied in pre-lamination, the foil becomes sticky and the air that is present cannot be properly pressed out of the glass package.

If glass is toughened (tempered), the high temperature and the ceramic transport rollers can cause wavy unevenness in the glass. This can result in the glass closing before the air can be pressed out of the glass package.
This unevenness in the toughened glass creates also results in different gap widths between the two glass lites sheets in a laminate, which then has to be filled by the foil. However, since the lamination foil can only compensate for unevenness to a limited extent, thicker foil or multiple layers thereof must be used in this case.

If the air humidity is too high, the foil is too “wet”. At the high temperatures in the autoclave process, the moisture can evaporate which in turn results in air bubbles. The connection between the foil and the glass surface, the so-called adhesion, is lost in this way.

DELAMINATION



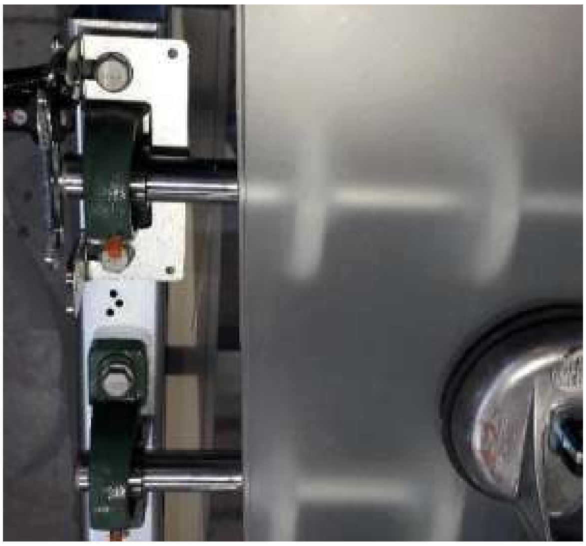
With delamination, the glass and the foil become detached again. This phenomenon occurs if the PVB foil which is accessible at the side edge of the glass comes into contact with water or is continuously in contact with water, for example. However, delamination can also occur if difficulties have already arisen during the lamination process. This example (see picture) once again shows how important a good edge seal is.

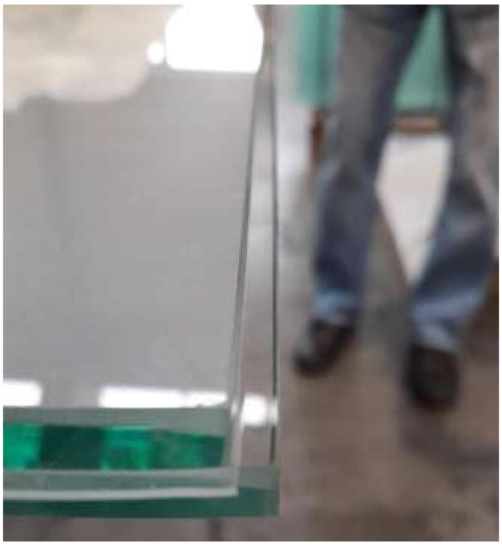
Improper storage of the foil, resulting in the moisture content being too high, can also lead to delamination. The adhesion between the glass and the foil is therefore reduced, which can either lead to the first signs of delamination after the autoclave, which are evident from round bubbles (ice flowers) - or not until the product has been used in a façade, for example. However, the quality of the “gluing” is also reduced in this case.

When PVB foils are stored, it is important to keep the temperature constant at around 18-22°C, and the air humidity at around 25-30% relative humidity. This requires a properly dimensioned climate chamber that is able to guarantee these conditions.

Material incompatibilities such as softener migration are also often the cause of delamination symptoms, which may not show in on the installed laminates until several months or years later.

OFFSET



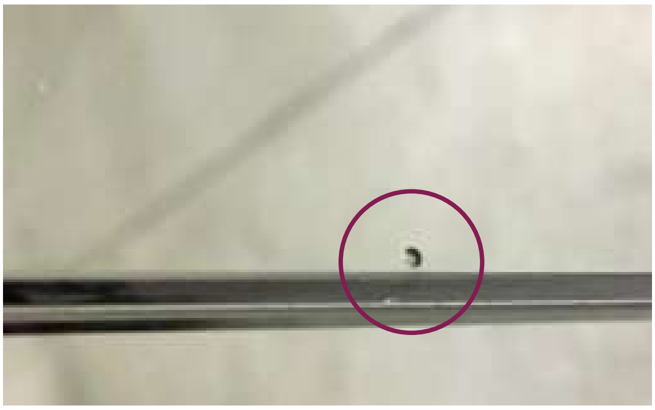


The problem of offsetting can occur during the positioning and overlapping of the glass in the assembly area or during pre-lamination.

If each pressing roller in pre-lamination is driven by its own motor, these must be perfectly synchronized, since uneven speeds can otherwise result in an offset. Irregular wear of the pressing rollers can also lead to the occurrence of offsetting after a certain time. In the event of smaller laminates or thinner cover glass lites sheets, incorrect application of the pressing roller on the front edge of the laminate can cause glass displacement. During the autoclave process, the laminates should always lie precisely at an angle of 90 ° from the clamping area to the rear wall support on the autoclave rack, since this can also lead to glass offsetting, which this particularly applies to large and heavy glass lites sheets.

AUTOCLAVE COOLING PROBLEM

The autoclave plays a very important part in lamination, in particular because the pressure, time and temperature parameters are so precisely defined. If, for example, the cooling register is defective or the cooling lines calcify, the cooling curve cannot be maintained and the laminated glass products are still too hot, whereas the pressure is already being reduced. This can lead to the formation of bubbles at the edges.



BUBBLE FORMATION DUE TO INCORRECT HOLDING TIME

The correct program must be created and selected depending on the glass structure of the lamination product. The holding time, i.e. the time during which pressure and temperature are present at the same time, plays an important role in this case. If the holding time is too short, the foil will not fuse completely. This creates gaps in the laminate, since the unevenness in the glass is not filled with foil quickly enough and sufficiently.

MINERAL AND ORGANIC IMPURITIES

Impurities such as this are usually caused by the washing machine and are attributable to inadequate maintenance of the water treatment system.
Examples of mineral impurities are lime and salts, for example, and examples of organic impurities are algae. Both can have a negative influence on adhesion in subsequent processes, which ultimately leads to delamination.

It is essentially the case that organic and mineral impurities can primarily be traced back to the water treatment. Cutting oil residues or other impurities on the glass surface can usually be attributed to the quality of the washing machine.

It must therefore always be ensured that the water treatment system provides water with maximum conductivity of 10 µS. A washing machine that is suitable for a lamination system must prevent the carry-over of dirty water and dry the glass surfaces and glass edges in the drying zone in such a way that they are completely drip-free.

CONCLUSION:

The lamination process is also becoming increasingly important in the glass industry. This is mainly due to the fact that the safety standards for installing glass components have been raised considerably and are constantly being improved. In order to make the production process stable and smooth, in-depth specialist knowledge is required. This is the only way to ensure that the end products have optimal quality and the technical safety requirements are fulfilled.

CHAPTER 3

Chapter Overview:

In Chapter 3 we deal intensively with pre-lamination, because this is where the majority of all essential production steps take place. This not only means that the quality of the end products is defined during the pre-lamination process, but that costs can also be saved. The following pages describe exactly how.

The important processes listed below are addressed here:

1. Heating zones

- Convection
- Radiation

2. Pre-lamination press

- Hydraulic or pneumatic application of pressing force
- Application of pressing force using spindle technology

Why is pre-lamination the heart of the lamination system and therefore extremely important?

However, pre-lamination is not only responsible for the initial affixing of the foil to the glass, but also has a significant influence on the wastage that can occur due to adhesion problems, delamination or bubbles in the glass lamination product.

Since the foils and the glass that are used (float glass as well as partially and fully tempered glass) are often very expensive, companies take great care to keep the amount of wastage as low as possible during lamination. Because this also has a direct influence on the manufacturing costs of a glass lamination product and therefore also on the operating profit of the respective company, of course.

Pre-lamination essentially consists of 2 processes:

- Heating zones
- Pre-lamination press

HEATING ZONE

Glass and foil are heated up in the so-called heating zone during the lamination process. This can be carried out with a pre-heating zone (approx. 120 ° Centigrade) and a main heating zone (approx. 220 ° Centigrade) or several main heating zones, depending on customer requirements. Each lamination glass package (at least one glass / foil / glass sandwich) continuously passes through these heating zones at a certain speed until the foil has warmed up to 60 ° Centigrade.

Basically, two thermal energy transport methods are available:

- Convection
- Radiation

The vast majority of lamination system manufacturers provide pre-lamination with both of the above-mentioned methods, since the combination of convection and radiation is crucial when it comes to being able to efficiently process glass lamination products with various types of glass with regard to their coatings.

Radiation is the better method for uncoated glass, since the radiant energy is channelled through the glass with high efficiency directly onto the foil, which then heats up accordingly. However, this is effect is reduced by coated glass types. Glass with a low-E coating, for example, reflects a large proportion of the radiation energy, meaning that the heat can only penetrate to the foil to a limited extent, if at all.
In cases such as this, convection is the most effective method of transporting thermal energy, since the energy is not reflected here but is transferred to the glass with high efficiency and then transferred to the foil.

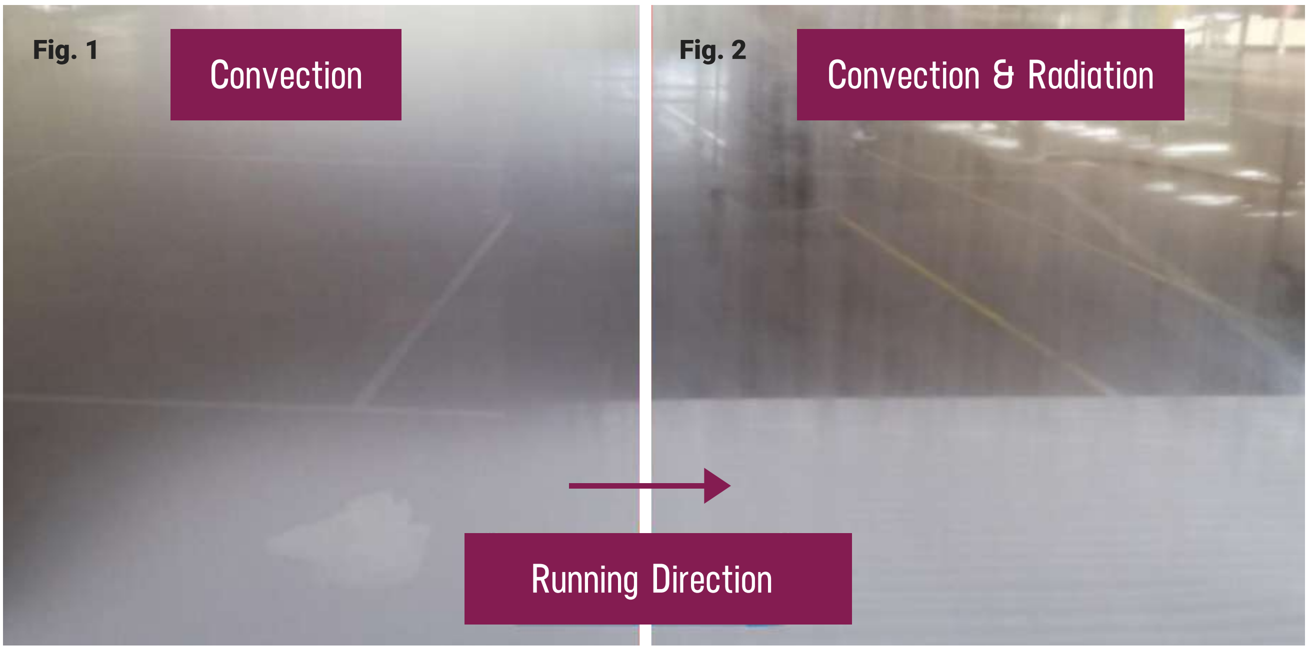
Incidentally: Radiation is one of the oldest and most widely used energy transportation options in the glass industry.

Lamination systems with pre-lamination are also used, whereby the thermal energy is transported exclusively by means of convection. The use of a so-called high convection oven (a tempering system with approx. 95% convection) such as an Aeroflat tempering oven is advisable for glass tempering because of the high temperatures of over 600°C.

Pre-lamination in which the energy is merely transported via convection is rather disadvantageous in the lamination area, since the thermal heat energy is redirected via the glass and reaches the foil relatively slowly. This is particularly noticeable in the case of thick glass lites sheets, since the entire glass mass always has to be heated up first. Of course, this results in very high energy consumption, and also leads to a loss with regard to throughput time in comparison to the radiation / convection combination.

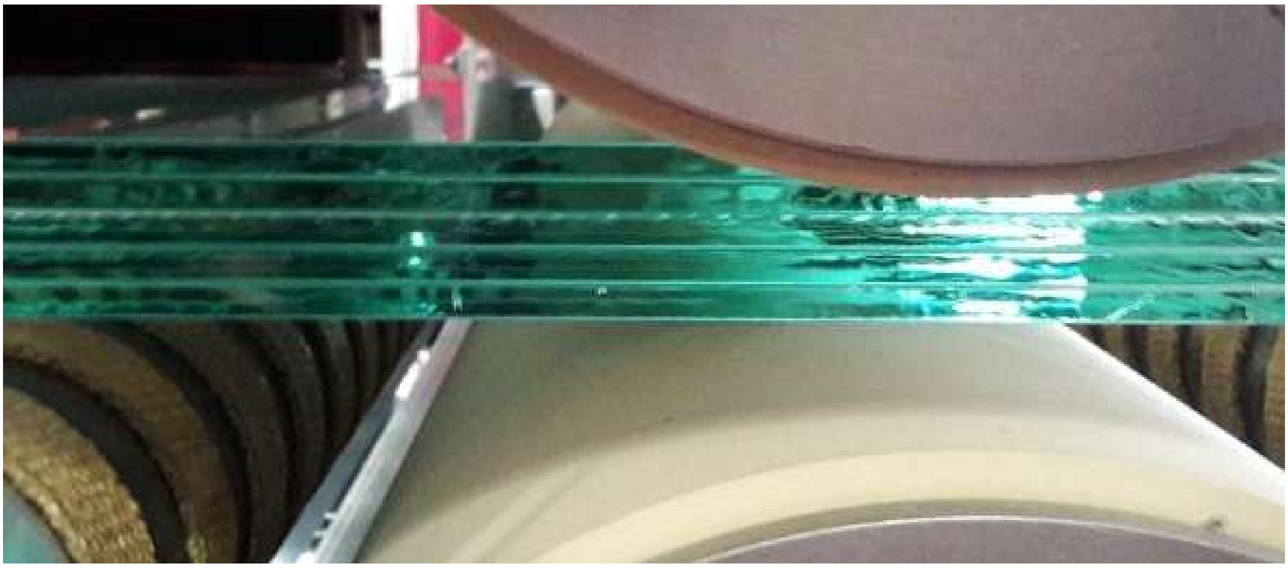
Here is an example:

Figure 1 shows glass that has first been heated with a combination of convection and radiation. In the second half, the radiation was then switched off whilst maintaining a constant speed. The picture shows very clearly that it was not possible to supply sufficient energy to heat the foil to 60°C. The structure, which was slightly permeable beforehand, is turned into a milky, non-permeable structure (red line in the middle of the picture), which is a clear indication of "too cold" pressing – i.e. the core temperature of the foil was insufficient.



PRE-LAMINATION PRESS

The pre-lamination press is one of the most important work steps during lamination, and also plays a major parts in the success or failure of the overall process. The press consists of two rollers that lie vertically one on top of the other. The glass is rolled between these rollers at a certain speed and pressed at the same time.



The pressure that is needed is applied to the warm glass package with the heated foil via the rollers in order to achieve the initial adhesion between the foil and the glass, and press the air out of the laminated glass sandwich.

It is of fundamental importance to ensure that a closed and all-round edge seal is created. Without this, air can penetrate into the laminating glass product during the autoclave process, among other things. For details concerning this problem, please refer to our blog post “How to recognise a high quality and safe glass laminate product”.

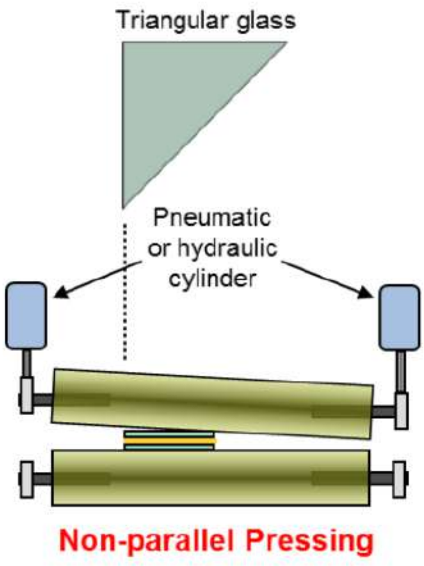
As well as the rollers, the process or the actuation of the pressing force on the rollers also play an tremendously important role – you could even go as far as to say that this is the real intelligence of pre-lamination pressing.

Two different technologies are available here:

- Hydraulic or pneumatic application of pressing force
- Application of pressing force using spindle technology

HYDRAULIC OR PNEUMATIC APPLICATION OF PRESSING FORCE

In hydraulic or pneumatic pressure distribution, the pressing force is applied by means of cylinders, which are actuated using either liquid or air (the most frequently used variant). However, this technology has the disadvantage that there is a relatively large tolerance range as far as the press gap and the press force are concerned, and there is also a considerable amount of wear.

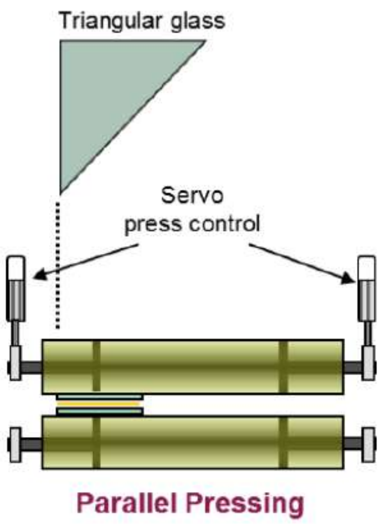


The hydraulic or pneumatic press is used by the majority of suppliers because the cost is lower, but the disadvantages cannot be dismissed out of hand.

The force distribution onto the pressing rollers is not even, because each side is equipped with a cylinder. This creates numerous problems – especially when special glass shapes are to be processed. It is also extremely difficult to adjust the press for an optimum edge seal with shapes, which also increases the amount of glass wastage.

The different glass shapes and the uneven actuation of the left and right sides of the press and the difficulty of placing the glass package exactly in the middle of the press make it even more difficult to produce a uniform edge seal.

APPLICATION OF PRESSING FORCE USING SPINDLE TECHNOLOGY



On the other hand, pressing force application using spindle technology is known to be very precise. Because the tolerance margin with this technology is very small in contrast to hydraulic and pneumatic press force application, and takes place within the range of tenths.

Furthermore, the combination of the intelligent control system and the spindle also makes it possible to carry out different pressing recipes and shapes depending on the customer's requirements (see image showing shape 1 and shape 2). This pressing technology can also be adjusted automatically at the push of a button within a matter of seconds - which is very complex and expensive with hydraulic and pneumatic technology.

This is why this spindle technology also provides a stable process and even pressure distribution - and this also applies to shapes. However, other complex products, such as multiple constructions for bulletproof glass or ultra-thin glass structures with 2 x 1 mm glass, can also be manufactured with the spindle without problems.

What needs to be considered when buying a pre-lamination system:

A pre-lamination system is normally purchased together with a new lamination system. However, since the pre-lamination system has to be functional in the hot area, the amount of wear is somewhat greater. As a result, the pre-lamination system may need to be replaced from time to time. This procedure is essentially possible without problems. However, it is important to analyse exactly which products you want to manufacture now and in the future and organise the system accordingly.

To save costs, only one heating zone and one press are often installed. This may well be OK for standard PVB foils. However, if complex foils are used or complex products are manufactured, an increased amount of convection must also be used - and then the preheating zone and a second press should definitely be considered. This will make the process operate in a stable fashion, and the amount of wastage can be significantly reduced.

CONCLUSION:

The pre-lamination system is rightly referred to as the heart of a lamination system, since the majority of the laminating process takes place there. On the one hand, the foils are heated up and bonded to the glass, but most of the air is also pressed out of the laminate.

The following two process steps are used for pre-lamination: Heating zones and the pre-lamination press. In the heating zones, the foil is heated to around 60 ° Celsius in order to then be pressed to the glass in an optimum way in the pre-lamination press by means of hydraulic or pneumatic press force application or using so-called spindle technology. It is particularly important to have an optimal edge seal, which then also makes the autoclave process run smoothly.

CONCLUSION

LiSEC has been working in the industrial processing of laminated glass for 25 years now, and has therefore also been able to develop sound expertise in the area of lamination. Due to increasing safety standards, the laminating process is significantly gaining in importance in the glass industry. The “heart” of a laminating system is pre-lamination. A large number of factors must be taken into account here, in order to produce efficiently and with high quality. It is not only the choice of the right laminating system for your own operation that is of elementary importance in this regard; the foils and the process of foil laying or cutting and glass alignment also have a major influence on the costs and quality of the entire procedure. Furthermore, extensive specialist knowledge is required to ensure the production process is stable during lamination and to guarantee the safety requirements.

If you have any questions after reading this whitepaper, please contact our experts, they will be happy to take the time to assist you with finding a solution for your individual challenges.

IDEALLY MAKE AN APPOINTMENT RIGHT NOW!

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