

A large, abstract graphic of flowing, layered paper sheets in shades of blue and grey, creating a sense of movement and depth. The sheets curve and overlap, with light reflecting off their surfaces.

About Paper

Self-adhesive paper

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1. Definition of a self-adhesive product

A self-adhesive product is a complex made up of three component parts:

- The **face stock material**: this is the product that will finish up as the label.
- The **adhesive**: its function is to keep the face material joined to the release liner. When these two elements are separated, the adhesive stays attached to the face material, forming the label.
- The **silicone-coated release liner**: this is the part which is eliminated after the label has been attached to the appropriate surface. The coating of silicone ensures that the adhesive will only be attached to the face material.

We can see the structure of the product in figure 2.



Fig. 2: Structure of the self-adhesive product.

In the following sections we shall discuss firstly, the production process for a self-adhesive product, and secondly, the various different raw materials which are used in the production process.

2. The production process for self-adhesive paper products

The production process for self-adhesives consists of the following steps:

- The application of silicone.
- The application of the adhesive.
- Conditioning.
- Formation of the adhesive complex.

We can see the whole process in diagram form at figure 3. It basically consists of passing the release liner paper through a machine head where silicone is added to it, thus producing silicone-coated paper. The paper is then passed through another machine head in which adhesive is added to it, and is subsequently joined to the face material so as to form self-adhesive paper. This product will then be sent through the different processes of finishing, winding, cutting, etc.

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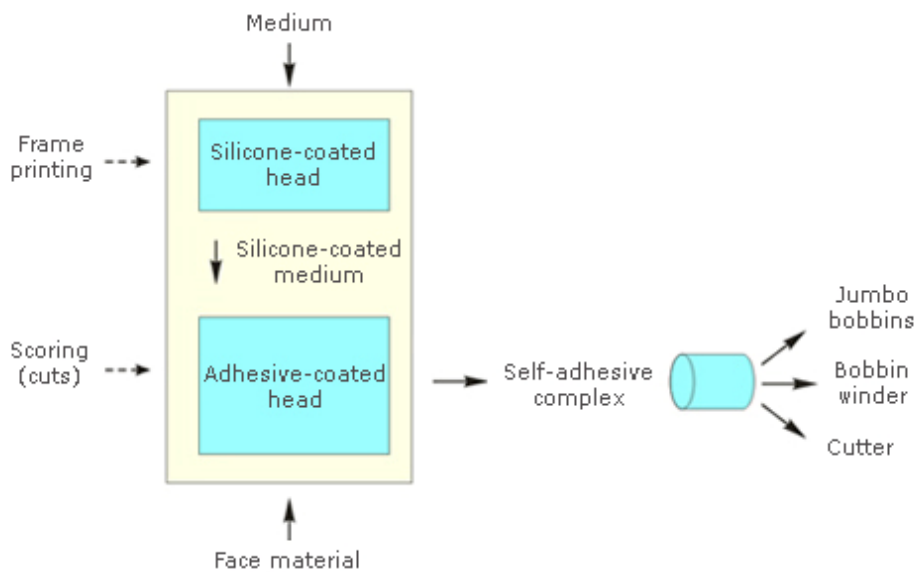


Fig. 3: The production process for self-adhesive paper products.

Figure 4 shows a diagram of the machine in which are carried out all the operations into which the production process of self-adhesive products is divided, and in the following sections we shall see at which points each of these operations is performed.

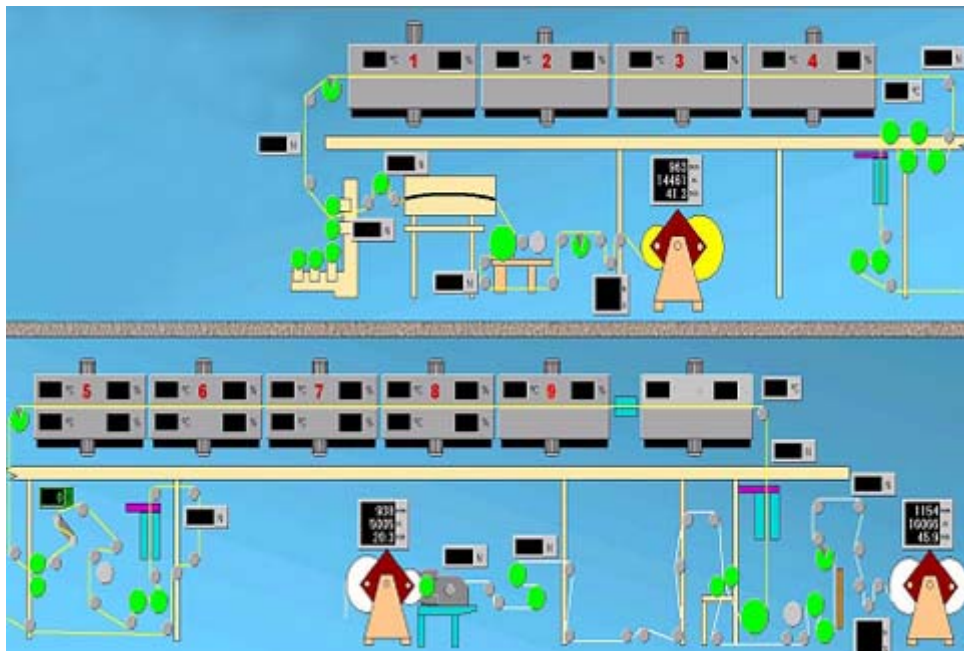


Fig. 4: Diagram of the production machine for self-adhesive products.

2.1. Application of silicone

The application of silicone consists of adding a thin **coating of silicone** to the release liner paper so as to attain the following objectives:

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- To make it possible to apply the adhesive and subsequently to transfer it to the face material.
- To protect the adhesive until its final use.
- To enable the face material to be easily detached from the release liner.

In fact the result of applying the silicone is to give the paper an **anti-adhesive** treatment which prevents the release liner and face stock material from sticking together. Many of us have at some time had the experience of removing a self-adhesive sticker, for example, only to find in some cases places where we can see that the face stock material and the release liner are stuck together, forcing us to work harder to unstick them. Well this is due to the fact that when the silicone was applied some zones did not receive the silicone coating, and it is here that the two pieces of paper will stick together.

The silicone coating that is applied to the release liner usually oscillates around the 1.2 g/m^2 range, depending on the type of release liner and the final product.

Once the silicone has been added to the release liner, the silicone-coated paper will enter a drying tunnel in which cross-linking and polymerization are produced at very high temperatures.

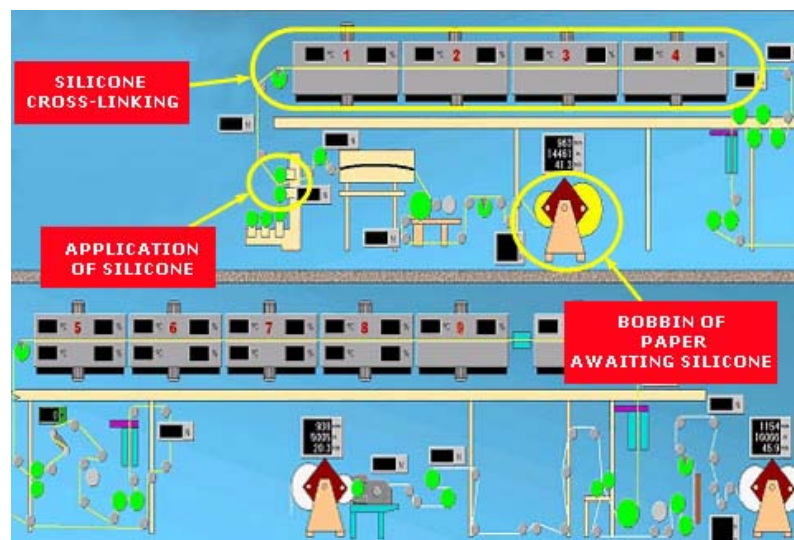


Fig. 5: Zones of silicone application.

The application of silicone is a process of great importance, since it has an effect on the property known as **release**, which measures the force of separation between the face material and the release liner. This point is highly important for printing in reels, when

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the process of matrix stripping will occur, as well as for the automatic application of labels in labelling machines:

- If the release value is very high, it could cause breakage of the texture with a resultant stoppage in the printing process, and breakdowns in the system for dispensing labels.
- If the release value is very low, labels may become unstuck from the release liner too easily before they can be dispensed for attachment to the relevant surface.

2.2. Application of the adhesive

Once the silicone coating has been applied to the release liner and the preceding operations have been completed, we can proceed to apply the adhesive to the silicone-coated release liner. In the manufacturing process for self-adhesive materials **pressure sensitive adhesives** are used, i.e., materials which only develop their adhesive force when they are subjected to pressure.

The quantity of adhesive which is applied to the release liner varies between 10 and 25 g/m², depending on the final use to be made of the product.

Once the adhesive has been applied, the following step is the **drying of the adhesive** in order to eliminate any water or dissolvent (according to the type of adhesive) that it may contain, so that it will adhere to the face material during the formation of the self-adhesive complex. Since the release liner has been given the anti-adhesive treatment through its silicone coating, the adhesive will thus only remain attached to the face stock material.

In figure 6 we can see the application of the adhesive and the drying of the adhesive.

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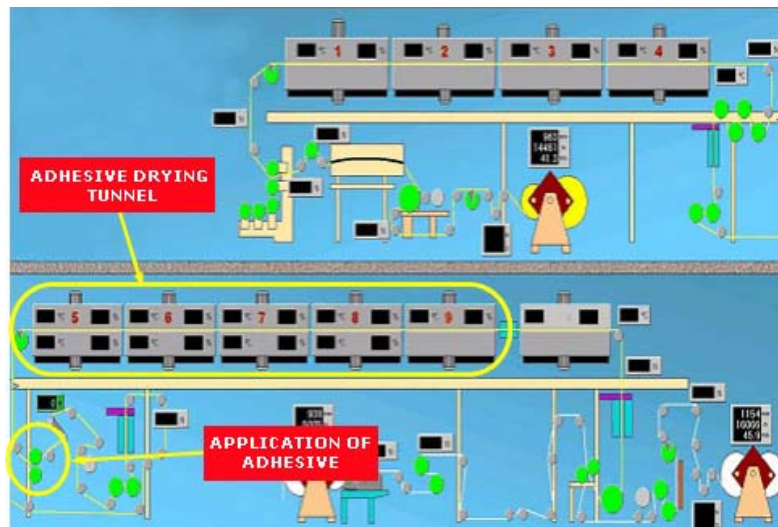


Fig. 6: Zones of application of the adhesive.

2.3. Conditioning

We have seen that during the application of silicone and of the adhesive the drying of the silicone and of the adhesive also takes place. However, during this drying process the paper is also dried, which is an unwanted side-effect, since, as we know, for the paper to react well during printing it needs to have an adequate level of humidity.

Conditioning is an operation which is carried out after the application of silicone and of the adhesive in order to give the product thus obtained the necessary level of humidity. It consists of passing the product through a **steam curtain** in which it is subjected to steam at low pressure. This operation is seen taking place in figure 7.

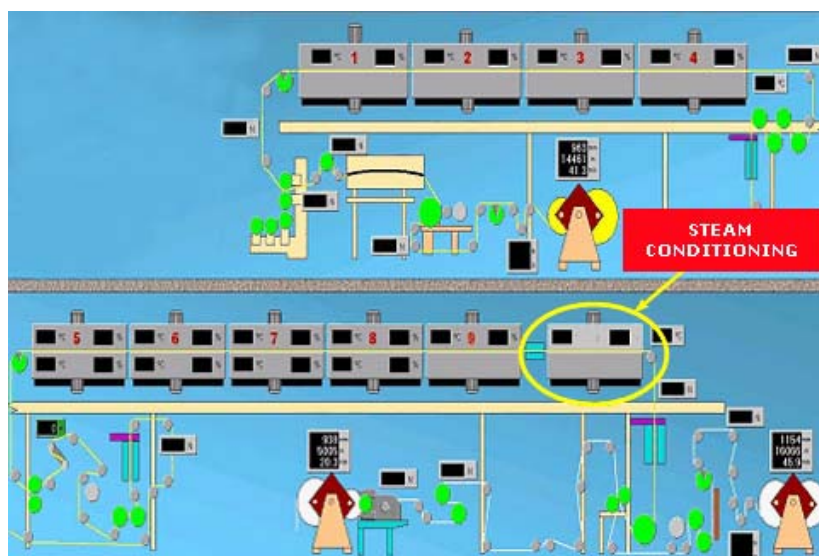


Fig. 7: Steam conditioning zone.

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2.4. Formation of the self-adhesive complex

When the adhesive is sufficiently dry and the paper has acquired the required level of humidity, the formation of the self-adhesive complex takes place, representing the final phase in the production of the self-adhesive product. To achieve this, the adhesive-covered release liner is joined to the face material by being passed through the contact point between two rollers (the "nip"), with both layers of material stuck together.

Given that the release liner has been given an anti-adhesive treatment through its silicone coating, the adhesive will only stick to the face material. From this point onwards the self-adhesive complex has been formed. The "nip" and the reel of self-adhesive product can be seen in the following illustration.

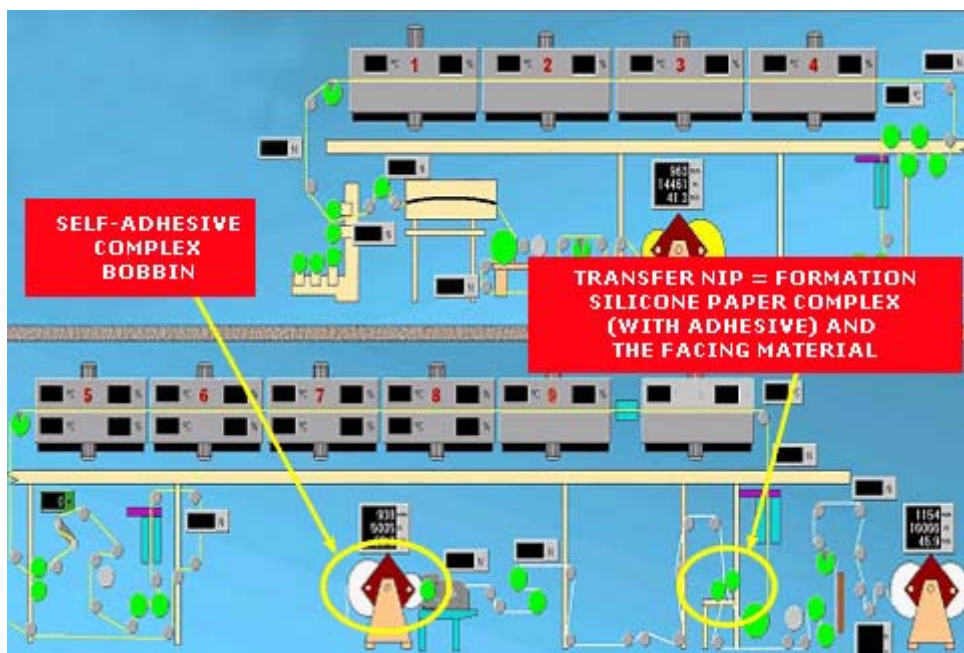


Fig. 8: Zones in the process of formation of the self-adhesive complex.

3. Special treatments

In addition to the basic operations that we have just examined, the following treatments can also be implemented during the production process:

- Reverse printing.
- Pre-scoring or pre-slitting.
- High opacity treatment

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3.1 Reverse printing

Reverse printing consists of printing a brand name on the reverse side of the release liner, which may represent a way of identifying the product. On some occasions manufacturers print their own brand name, and in other cases they may print that of their customers. Products may also remain unmarked, especially for some uses, such as stickers, when the printer needs to print on the reverse side the numbers and names of the characters being printed.

Printing is carried out using a flexographic system just before the silicone is applied, as can be observed in the following illustration.

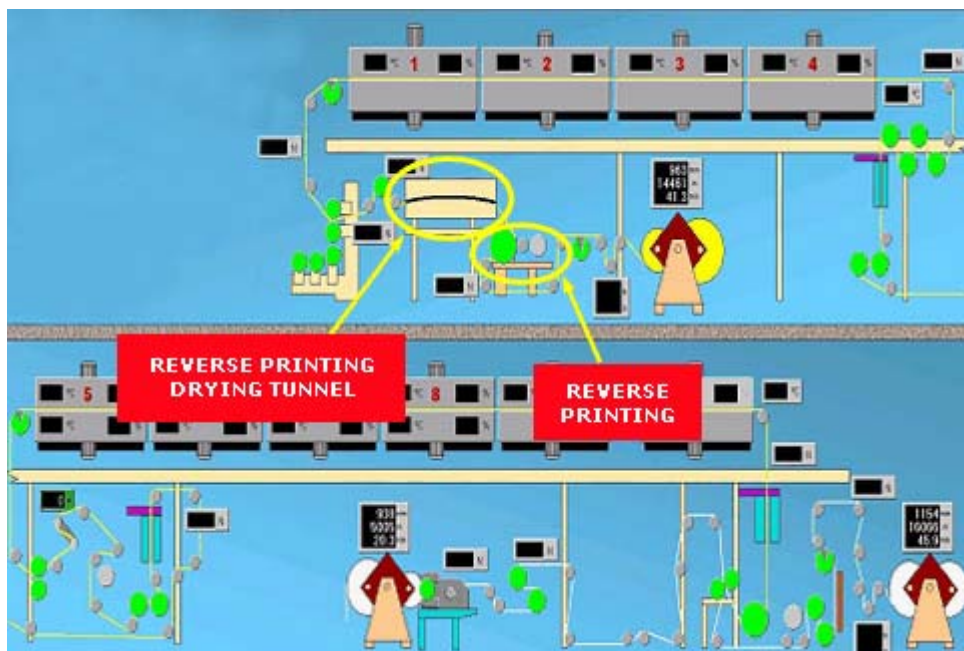


Fig. 9: Reverse printing zone.

3.2 Pre-scoring or pre-slitting

This is an operation designed to **facilitate the separation of the release liner** in order to detach labels when they are very small. The release liner must not in fact break during the production process, which is why we call it pre-scoring, since it must only break when it is folded in two by the final user. In addition to this, the liner must only break at the cut which is folded over, and not at other points.

The liner is pre-scored mechanically and the slits are produced parallel to the direction of the paper's fibre, with a distance between two cuts of 3.6 cm. There are nevertheless also manufacturers in the market who pre-score using acid.

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Cuts are made only in special production lines intended for the printing of **small labels**. In the same way, this operation is carried out exclusively in the case of self-adhesives produced in **sheets**, in which the application of labels is manual, and it is not necessary to use reels, for which the application is automatic.

3.3 High opacity treatment

High opacity treatment is intended to make the **face stock material totally opaque** so that it can be used in special cases such as, for example, covering previous prices for certain products and replacing them with new ones. This is common in the pharmaceutical sector when there are price changes and it is wished to use all the old packaging on which the price is already indicated. The label with the new price will be placed just on top of the old price and, thanks to its high opacity, will cover it completely.

High opacity treatment can be implemented in two ways: by colouring the reverse of the face stock material, or by colouring the adhesive, the former of the two options offering the best guarantee of quality.

4. Raw materials

As we have seen, there are three raw materials for producing self-adhesive articles:

- Release liners.
- Adhesives.
- Face stock materials.

The different types of self-adhesive articles that are produced depend on the type of face stock material, adhesives and release liners used. We will now discuss each of these elements.

4.1. Release liners

The release liner, as we have seen, is the material that is used for applying the adhesive and transferring it to the face material, in addition to protecting the self-adhesive until it is finally applied, so that we can easily remove the face material with the adhesive. In order to enable it to do this, the release liner will receive an anti-adherent treatment through the use of silicone.

Release liners may be of various different types and are differentiated principally according to whether the final product is to be supplied in the form of reels or sheets. The use of different release liners depends on the type of face stock material, the system for applying labels, etc.

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Release liners for reels

When the self-adhesive paper is produced in reels, the application of the labels is usually **automatic**. This means that the labels applied to the release liner will be put in place through the operation of a photoelectric cell, which will generate a beam of light that will need to pass through the release liner, since it is positioned behind it. This determines what degree of opacity these products can have, which is one of the key factors. They are therefore produced using semi-transparent paper of a high level of refinement, which makes them unstable. Other required features will be to have uniform weight and thickness in order to withstand die-cutting.

Release liners used for reels are usually known by the name **glassines** due to their transparency, and are as follows:

TYPES OF GLASSINE RELEASE LINER FOR REELS

- Semi-transparent amber and blue glassine in substances of 50 g/m².
- Semi-transparent amber, white and blue glassine in substances of 62 g/m².
- White glassine in substances of 80 g/m².

In addition, there are also reels which use **Kraft** release liner (although this is a release liner paper which cannot be used for automatic application) because they will subsequently be converted into sheets. This happens in the case of laser quality products.

TYPES OF KRAFT RELEASE LINERS FOR REELS

- White Kraft Laser release liner in substances of 55 g/m².
- White Kraft Laser release liner in substances of 74 g/m².

Release liners for sheets

Release liners for sheets have a **higher substance** than those used for reels. Depending on whether they are with or without pre-scoring, and on the type of face stock material, we can use the following types:

TYPES OF KRAFT RELEASE LINER FOR SHEETS

- White Kraft release liner in substances of 80 g/m² without pre-scoring.
- Yellow Kraft in substances of 87 g/m² with and without pre-scoring.
- White Kraft release liners in substances of 90 g/m² with and without pre-scoring.
- White Kraft release liners in substances of 130 g/m² for plastic face stock materials.

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Release liners for sheets must also have a high level of regularity of caliper in order to react well to die-cutting.

4.2. Adhesives

Depending on their composition, adhesives can be found in four main types:

- **Water-based emulsion (or acrylic) adhesives.** These are made up of polymers dispersed in water. The most widely-used types are acrylate dispersions (water-based acrylic adhesives).
- **Solvent-based adhesives.** These are made up of solutions in an organic dissolvent with different components (rubbers, resins, etc.).
- **Hot-melt adhesives.** These are made up of mixtures of rubber with resins, plasticizers and other additives which, when producing the self-adhesive complex in melted form, are applied by means of heat (with temperatures of higher than 120 °C). Neither dissolvents nor water are used.
- **UV cross-linking adhesives.** This is a new technological development in the field of self-adhesives. Like hot-melt adhesives, they are 100% solid and are applied in melted form, and are subsequently cross-linked using ultraviolet radiation.

In the following table will be found indicated both the main advantages and disadvantages, and the applications of the different types of adhesives that we have just seen.

| CHARACTERISTICS OF ADHESIVES | | |
|--------------------------------|-------------------------|--|
| Water-based emulsion adhesives | Advantages of use | <ul style="list-style-type: none"> - Easy to handle. - No fire risk. - Low pollution level. |
| | Advantages for handling | <ul style="list-style-type: none"> - Good resistance to sunlight, oxygen and heat. - Limited tendency to migration. - Combines well adhesive capacity, cohesion and tack. - Few flow problems. |

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| | | |
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| | Disadvantages | - Low adhesive capacity in nonpolar release liners and at low temperatures. |
| | Applications | - Covers the majority of applications. |
| Solvent-based adhesives | Advantages of use | - Good tack. - Good adhesive capacity. |
| | Disadvantages | - High cost. - Dangerousness. - Unecological. |
| | Applications | - Pasteurization, nonpolar surfaces. |
| Hot-melt adhesives | Advantages | - Good tack. - Excellent adhesive capacity with moist release liners. - Good adhesive capacity with nonpolar release liners. |
| | Disadvantages | - Low heat resistance. - Front migration. - More pronounced tendency to ageing (in terms of resistance to UV rays, oxygen, etc.). - Few manufacturers of raw material. |
| | Applications | - Especially effective on moist and cold surfaces. |
| UV cross-linking | Advantages | - Good resistance to water, heat and UV radiation. |
| | Disadvantages | - Are still in the development phase. - Only one supplier. |
| | Applications | - With plastic face stock material for personal care, cosmetics and for sealing packets of damp face-towels. |

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The adhesives used at Torraseda are of the water-based acrylic type. We have a wide variety of products available, depending on their final use.

4.3. Face stock materials

The face stock material is the front part of the self-adhesive, which will finish up as a **label**. A wide variety of face stock materials can obviously be chosen, depending on the quality required, the release liner used, etc.

The different varieties of face stock material that we have available are listed below.

- White.
- Laid, coloured and fluorescent.
- Laminated and metallized.
- Thermal and carbonless
- Films.

5. Quality control

Leaving aside the question of quality control for raw materials, in this section we shall basically concentrate on quality controls carried out on the adhesive complex, which are as follows:

- Peel or adhesive capacity.
- Quick stick.
- Rolling ball.
- Cohesion.
- Release.

5.1. Peeling or adhesive capacity

According to their adhesive capacity, adhesives are commonly classified as follows:

- **Removable.** Adhesives that can be taken off once they have been stuck on.
- **Permanent.** Adhesives that cannot be taken off once they have been stuck on.
- **Super-permanent.** These are used when there are problems with the adhesive capacity of the release liner to which the label is attached.

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The peeling or adhesive capacity test is a way of measuring the product's **adhesive capacity**. According to the result, the adhesive will be defined as superpermanent, permanent or removable. The equipment for carrying out the test to determine the adhesive capacity can be seen in figure 10.



Fig. 10: Peeling or adhesive capacity test.

The characteristics of the peeling test are indicated in the following chart:

| PEELING OR ADHESIVE CAPACITY TEST | |
|-----------------------------------|---|
| Description of the test | The force required to remove at 180° and 300 mm/min a sticker 25 mm wide attached with the pressure exercised by a roller weighing 2 kg on a plate of various different materials (stainless steel, polyethylene and cardboard) after specific periods of attachment (20 min, 24 hours and 1 week). |
| Reference standard | FINAT FTM 1 |

5.2. "Quick stick" test

This test measures the **tack** (or stickiness) of the adhesive. Tack is very important for automatic applications. A high level of tack means that the adhesive will be attached as soon as it touches the release liner.

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For manual applications the tack is less important, since the person who sticks on the label can subsequently apply the pressure required for it to remain attached. For example, for stickers it is better to have a low tack which makes it possible to unstick the sticker if we have stuck it in the wrong place. Logically this will always be for a short space of time, since the adhesives will increase their adhesive capacity over time.

The characteristics of the "quick stick" test are shown in the following chart:

| "QUICK STICK" TEST | |
|--------------------------------|---|
| Description of the test | The force required to remove immediately at 300 mm/min a 190 x 25 mm strip of adhesive face material attached to a plate of stainless steel measuring 25 x 25 mm. |
| Reference standard | FINAT FTM 9 |

5.3. "Rolling ball" test

This test is also designed to measure **tack** and we can see an example in the following figure:



Fig. 11: "Rolling ball" test.

The characteristics of the "rolling ball" test are shown in the following chart:

| "ROLLING BALL" TEST | |
|--------------------------------|---|
| Description of the test | The distance (in cm) covered by a stainless steel ball 11.1 mm in diameter that falls onto a flat surface inclined at an angle of 30° and |

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| | |
|---------------------------|---|
| | which rolls onto a sample, its movement being then restrained by the sample's adhesive film. The slower the rolling ball moves, the greater the tack. |
| Reference standard | PSTC 6M |

5.4. Cohesion

The cohesion of an adhesive gives us an idea of its **resistance to fluidity**. This is a classic problem when we try to guillotine self-adhesive sheets, since if the adhesive does not have sufficient cohesion it can flow over the edges and the sheets will stick to one another.

Cohesion is very important, for example, in the case of adhesive for stickers, when it is necessary to make a very large number of guillotine cuts. The test can be seen in figure 12.

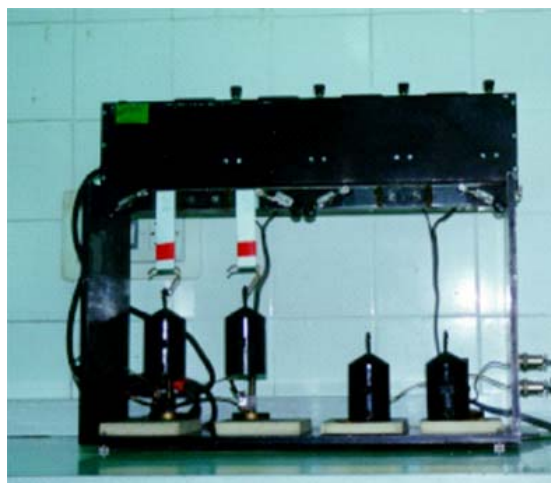


Fig. 12: Cohesion test.

The characteristics of the cohesion test are indicated in the following chart:

| COHESION TEST | |
|--------------------------------|--|
| Description of the test | Interconnection or fragmentation force of an adhesive film in two parts when two |

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| | |
|---------------------------|---|
| | different forces are applied. The test is based on the time required for a 1 kg weight to produce an internal fracture in the adhesive film of a sample strip stuck to a plate of glass at an inclination of 2° from the vertical. |
| Reference standard | FINAT FTM 8 |

5.5. Release

Release is the **force that separates the face material and the release liner**, and is a very important factor in the printing process and the process of matrix stripping (in the case of reels), and also for the automatic application of labels. Figure 13 shows the equipment used to carry out this test.

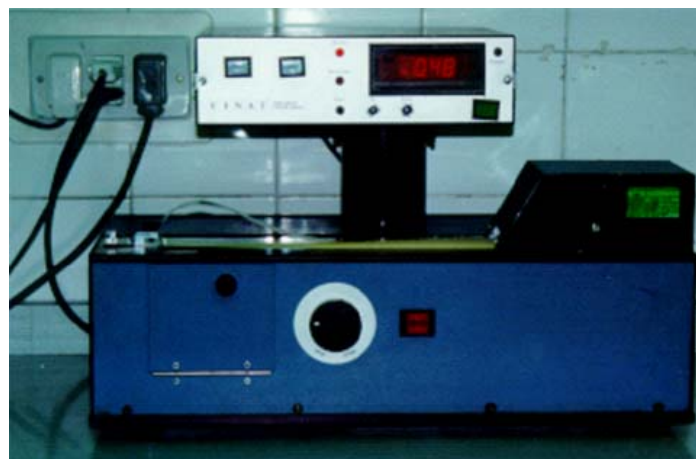


Fig. 13: Release test.

We carry out the release test at two different speeds:

- **Low speed** (300 mm/min).
- **High speed** (150 m/min).

The characteristics of the release test are shown in the following chart:

RELEASE TEST

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| | |
|--------------------------------|--|
| Description of the test | <p>The force required to unstick adhesive-applied face stock material from the silicone-coated release liner to which it is attached as part of a single adhesive complex.</p> <ul style="list-style-type: none">■ Low speed test (300 mm/min): sample 5 cm wide x 19 cm long.■ High speed test (150 m/min): sample 3 cm wide x 70 cm long. |
| Reference standards | <p>Low speed: FINAT FTM 3</p> <p>High speed: FINAT FTM 4</p> |

6. Finishings

Before being sent out to customers, adhesive products are subjected to finishing operations in which they are given the required format. Self-adhesive products can be presented in the form of reels or of sheets, and in each case the most suitable printing system will be used.

- **Reels.** Reels are preferably printed using the techniques of flexography and, to a lesser extent, typography, gravure and screen-printing. There are now also some offset machines available for special applications.

Figure 14 shows a detailed view of a winding-machine. As can be seen, the reels used for self-adhesive products are generally small in format.



Fig. 14: Detail of a winding-machine for self-adhesives.

Reels are generally used for **automatic** applications, barring very rare exceptions. Below are shown various different labelling machines.

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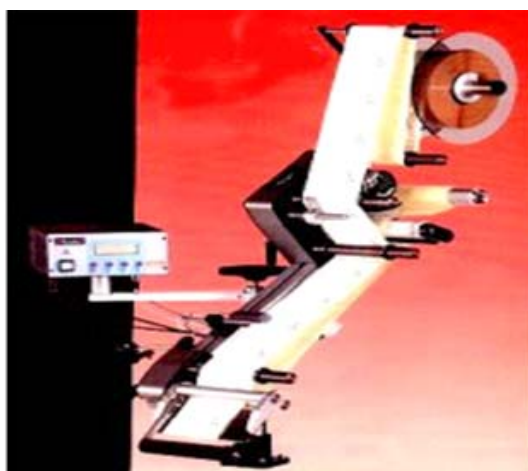
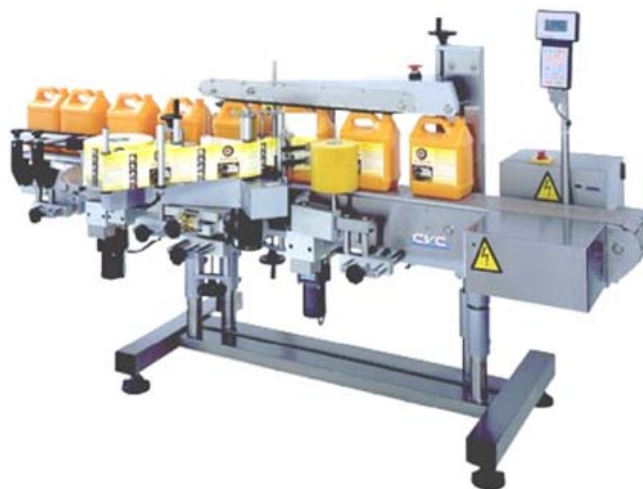


Fig. 15: Different labelling machines.

- **Sheets.** Sheets are generally printed offset, and, to a lesser extent, using silkscreen printing, especially in the case of pasted or metallic surfaces and of

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films. If the labels to be produced are very small, a release liner with pre-scoring will be chosen to make it easier to detach them.

Labels coming from sheets are always applied **manually**. For this reason, as has already been noted, aspects such as tack, or even release, are less critical than is the case when reels are used.

The cutting-machines used are the same as those used for standard paper. One particularity that should be borne in mind is that the blades of the finishing machines accumulate adhesive during the cuts, and for this reason need, occasionally, to be cleaned with silicone to avoid a proliferation of patches of adhesive on the face stock materials.

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Summary

Components of the self-adhesive product

The self-adhesive complex is made up of three component parts:

- **Face stock material:** constitutes the final label.
- **Adhesive:** its function is to keep the face material joined to the release liner until its final use.
- **Release liner:** protects the self-adhesive until its final use.

Stages in the process

The production process for self-adhesives consists of the following steps:

- **Application of silicone:** a coat of silicone is applied to the release liner and is subjected to a process of cross-linking and polymerization at high temperatures.
- **Application of the adhesive:** the adhesive is applied to the silicon-coated release liner, and is subjected to a drying process.
- **Conditioning:** the adhesive-coated product is passed through a steam curtain so as to produce an adequate degree of humidity in the paper.
- **Formation of the complex:** the adhesive-coated release liner is joined to the face material so as to form the self-adhesive complex.

Raw materials

The **release liners** that are used are glassines (50, 62 and 80 g/m²) and Kraft (55 and 74 g/m²) in the case of reels, and Kraft (80, 87, 90 and 130 g/m²) in the case of sheets.

The **adhesives** can be of four different types: water-based emulsion adhesives, solvent-based adhesives, hot-melt adhesives and UV cross-linking adhesives.

The **face stock materials** may be of numerous different types and may be grouped together in the following categories: white; laid, coloured and fluorescent varieties; laminated and metallized varieties; thermal and carbonless varieties, and films.

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Quality control

The self-adhesive complex is submitted to various quality control processes which are implemented by means of the following tests:

- ▣ Peeling or adhesive capacity.
- ▣ Quick stick.
- ▣ Rolling ball.
- ▣ Cohesion.
- ▣ Release.

Finishings

Self-adhesive products can be presented in the form of reels or of sheets. In the former case they are usually intended for automatic applications and in the latter case for manual applications.

The preferred printing technique for reels is flexography (and to a lesser extent typography, rotogravure and silkscreen printing), whilst for sheets offset printing (and to a lesser extent silkscreen printing) is generally used.

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