

## **Polymers Laminates Adhesives Coatings & Extrusions. All Of These Can Benefit In Some Way From Flame Treatment**

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### ***Flame Treatment***

Polarisation of a substrate can greatly improve its adhesion qualities. Applying a flame to a continuous web does exactly this and if applied prior to further applications such as lamination, inks or adhesives enhances bonding.

Flame treatment is widely used in a number of applications from the “Pre-treatment” of carton board before lamination to the “Post-treatment” of film such as prior to special coatings such as low adhesive backings.

### **The Application**

#### **Pre-Treatment**

##### *Liquid packaging – carton board laminating lines*

Carton board utilised in liquid packaging requires surface treatment to improve the adhesive bond between it and an applied laminate. Situated at the beginning of the coating line the gas burners are used for conditioning both sides of the web prior to the lamination process.

##### *The lamination*

When flame treatment is used good adhesion occurs, upon attempting to remove the laminate from the surface of the board the fibres in the board tear rather than the polymer delaminating.

##### *The Process*

The flame treating burners are situated in a position to fire directly onto the surface of the board as it passes by at speed. Chemical changes occur in the substrate, however because the web is moving the dwell time of the flame is not great enough to cause any heat damage.

## *The Technology*

As with any process, refinement of the operating parameters allows for greater accuracy and repeatability within the process. Some of those parameters are shown here firstly the stability of treatment the flame produces treatment that will remain for a long period there is very little decay. Also the dwell time is a crucial parameter which directly co insides with the flame energy that is applied to any given surface area. As we cannot control the speed of the web we modulate the size of the flame accordingly.

Crucial parameters such as the air / gas ratio of the flame allow for fine tuning of the process. Many products require their own particular process parameters to achieve the best treatment condition. We can use certain parameters as a bench mark for achieving treatment but when optimising a system we must fine tune the system to take into account the gas type being used, the substrate and also the local ambient conditions.

The control of the flame for high quality results across a broad range of substrates at high speeds require the following parameters to be tuned.

### *Combustion conditions – Air / gas ratio*

Flame treatment requires a slightly air rich flame that utilises all the combustibles in the combustion process. The excess oxygen in the products of combustion is crucial to activating the surface of the substrate.

### *The burner to substrate gap*

There is an optimum area just off the inner cones of the flame that must come into contact with the substrate. This is known as the active zone of the flame. Different flame profiles can be produced which can be suited to various substrates.

### *The dwell time of the substrate in the flame*

This works hand in hand with the flame energy. The flame size is modulated in accordance with the line speed, too much flame at a low speed and the substrate can potentially be over treated, over heated and lead to shrinkage of the web and excessive gas use.

### *Flame energy*

Too little output at high speeds and the web potential can be under treated leading to poor adhesion. This all relates to the Flame energy

The latest technology innovations in the flame treatment industry are refining the way that the flame is taken care of, both optimising the flame control for the benefit of the process and equally optimising the overall gas consumption of the system. Latest combustion generators contain all controls including oxygen analysers, flow meters and

regulators. Latest systems have burner position controls to ensure the positions of the flame relative to the web and the burner output is optimised.

#### *The system layout*

Here we see the typical layout of two pre treatment hoods for the treatment of both sides of the web. The exhaust hoods are there to remove the excess heat and dilute it with ambient air to make its temperature safe to run through ducting

#### *The system layout*

Depending on the production requirements the flame treatment systems can be utilised in a single or double burner configuration. In both cases the treaters are situated prior to the first laminator.

#### *The valve train*

To control the flame in a suitable manor the gas valve train has automatic controls monitored and modulated by an integral PLC. The flame energy is modulated via either the speed of the combustion fan on a single burner system or by “capacity valve” on a double burner unit. The flame energy is automatically tuned to give the optimum treatment for any given line speed.

A crucial part of the mixture generator is the oxygen analyser. This allows for automatic monitoring of the air gas ratio of the flame. The signal from this unit is used to fine tune the gas supply to the flame, this ensure that the same flame condition is maintained at all times and even if the consistency of the gas changes, as it often does the treatment results remain constant. The oxygen analyser measures directly the condition of the flame something that cannot be achieved using flow meters.

Flow meters are installed in the system allow for the monitoring of the flow of gas to the burners.

#### *The control Instrumentation*

Digital controls allow for easy self explanatory operation of flame treatment equipment. Flame controls such as the oxygen analyser are integrated with PLC.

#### *Gas savings*

All the above controls have been specially designed to optimise the effectiveness of the adhesion enchasing qualities of flame treatment. However they also have the great benefit of reducing gas consumption.

Automatic flame deckling, burner positioning relative to web and the use of the oxygen analyser all reduce the gas consumption to a minimum.

### *The advantages of flame “Pre-treatment”*

The advantages of flame pre treatment are primarily much improved bond strength. Other advantages that are unique to the flame are that it de wicks the surface of the substrate eliminating the possibility of pin holing and unlike other treatment systems here are also no adverse by products from the process such as ozone or volatile organic compounds.

### **Post Treatment of films and laminates**

#### *Post Treatment*

Flame treatment of film and laminates is known as “Post-treatment”. Post-treatment is ideal for improving the adhesive qualities of substrates such as Polypropylene film which are otherwise are very difficult to print on. The adhesion improvement allows for print laminate or adhesives to be applied. Products that often require post treatment are gift wrapping flower sleeves, textile wrapping, stationary and adhesive tapes. Post-treatment of film for adhesive tape so that low adhesive backing coatings can be applied is also common.

#### *The application – Film*

Many substrates in the food packaging industry also benefit from Post-treatment. Extra high treatment levels can be achieved and promote good print adhesion. This is essential as it is often the labels that sell us the product rather than the food inside.

#### *Post Treating Technology*

Typically two burners are required for post treatment of film webs. Due to the very thin nature of the substrate the flame needs to be applied in a much gentler, dispersed manor. Two burners are usually used in series especially for very high speed applications up to 800m/min. Post treatment requires the use of a backing roller. This allows for the heat of the flame to pass directly through the substrate with out damaging it.

#### *New technology*

Burners from the post treatment of film are now crossing over to the pre treating process in the converting industry. The burner technology has greatly progressed using modular aluminium designs to take over from the more traditional cast iron units.

### *New Burners*

New burner designs emerging are of modular design, allowing for simple assembly and strip down. They have the benefit of interchangeable ribbon packs. This is most suitable if a flame treater has the demand of a wide variety of substrates to treat especially if they are of a broad range of thicknesses.

New burner designs are also incorporating integral water cooling channels. All large wide web burners have to be water cooled. This helps prevent deflection when running and ensures the burner to product gap is consistent across the width of the web. Also the water cooling prolongs the life of the burner as without it constant deflection can damage the casting.

### *The advantages of Post treatment*

High treatment levels can be achieved with flame opposed to other surface treatments such as corona. The flame also has other benefits such as no back side treatment and very little decay rate of treatment, so product can be stored prior to further print applications being made. The burner technology will continue to change as new products and process are developed.

### **Summery**

Flame treatment is widely used in a number of applications for enhancing the adhesive qualities of a variety of materials. Flame has endless uses in the converting industry for both “Pre-treatment” and “Post-treatment”. The continues development of both processes will assist in furthering the design of the systems.

Flame treatment allows for the surface of the substrate to be activated and dramatically improve adhesion qualities. This is very unique as the flame treatment process allows for the substrate to be activated at line speeds of up to 650 m/min

The new combustion generators and burner hoods are giving greater levels of automation to further improve the size of the flame its position relative to the web and also the consistency of the flame. The latest burner controls are put in place to give fine control of the flame primarily for the process allowing for good adhesion results however this also dramatically reduces gas consumption so at the same time the system is continuously running efficiently.

A number of new innovations have been developed recently to further the accuracy and level of treatment that can be achieved. This has also resulted in more efficient gas consumption. All these factors contribute to flame remaining at the leading edge of surface treatment technology.

**Polymers, Laminates, Adhesives,  
Coatings & Extrusions.**

**All of these can benefit in some  
way from flame plasma treatment**

# FLAME PRE TREATMENT OF WEBS.

Polarisation of a substrate can greatly improve its adhesion qualities. Applying a flame to a continuous web does exactly this and if applied prior to further applications such as Lamination, inks or Adhesives enhances bonding.

Flame treatment is widely used in a number of applications from The Pre – treatment of carton board for laminating too the Post - treatment of film for specialty coating such as Low Adhesive Backings.



# THE APPLICATION

## LIQUID PACKAGING – CARTON BOARD LAMINATING LINES

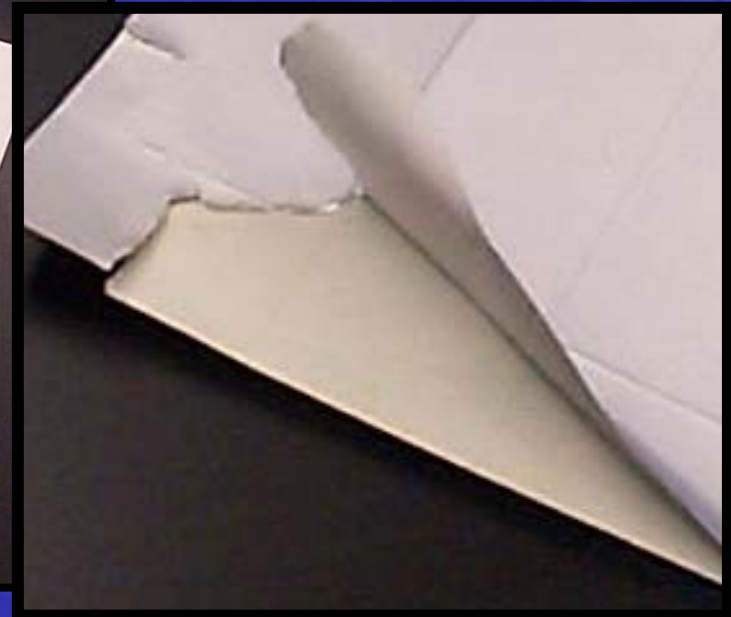
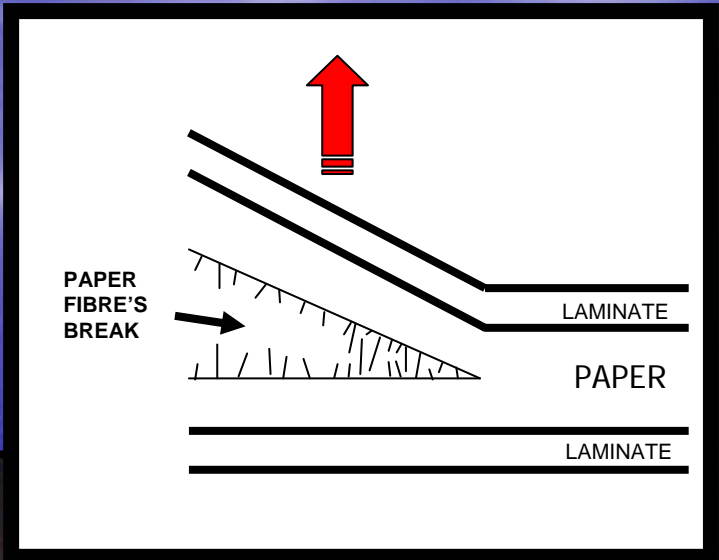
Carton board utilised in liquid packaging requires surface treatment to improve the adhesive bond between it and an applied laminate. Situated at the beginning of the coating line the gas burners are used for conditioning both sides of the web prior to the lamination process.





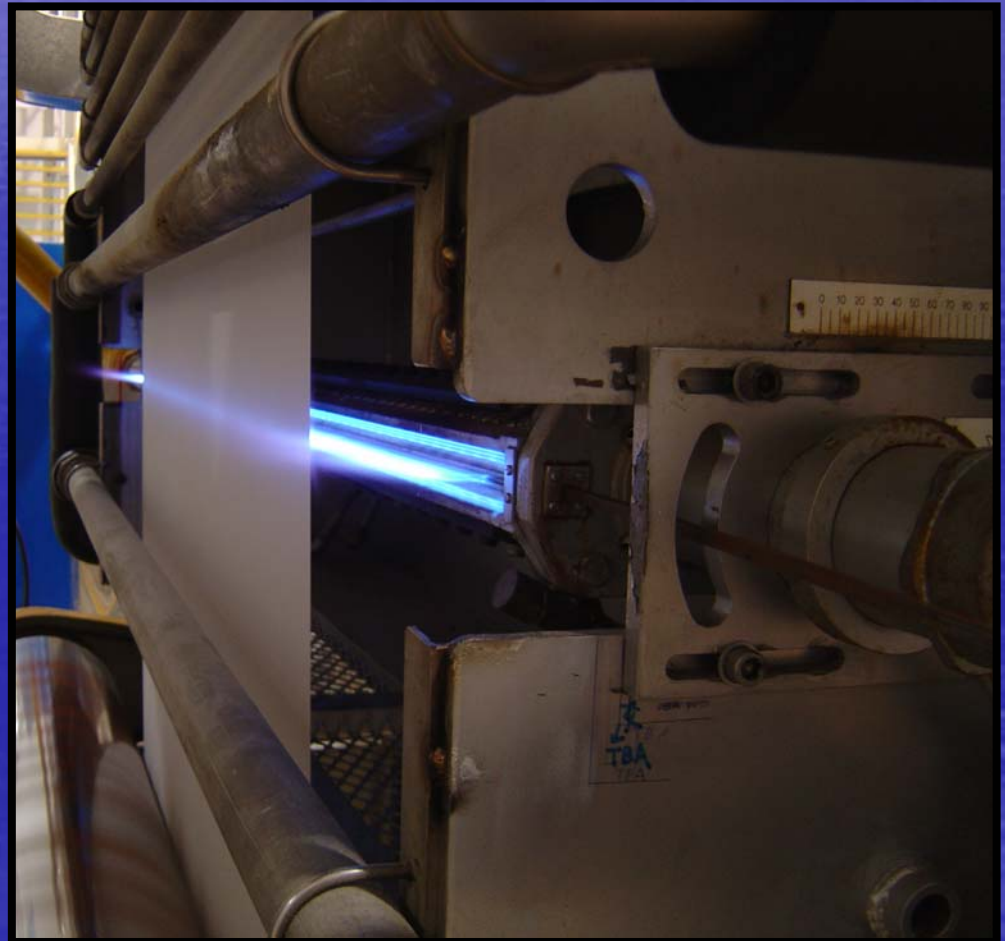
## THE LAMINATION

When flame treatment is used, good adhesion occurs, upon attempting to remove the laminate from the surface the fibres in the board tear rather than the LDPE de laminating.



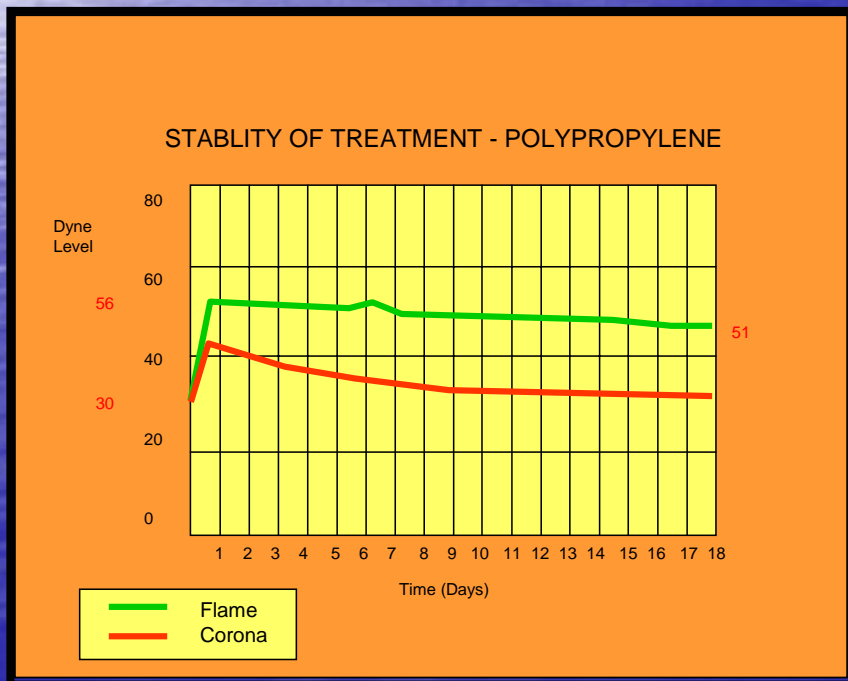
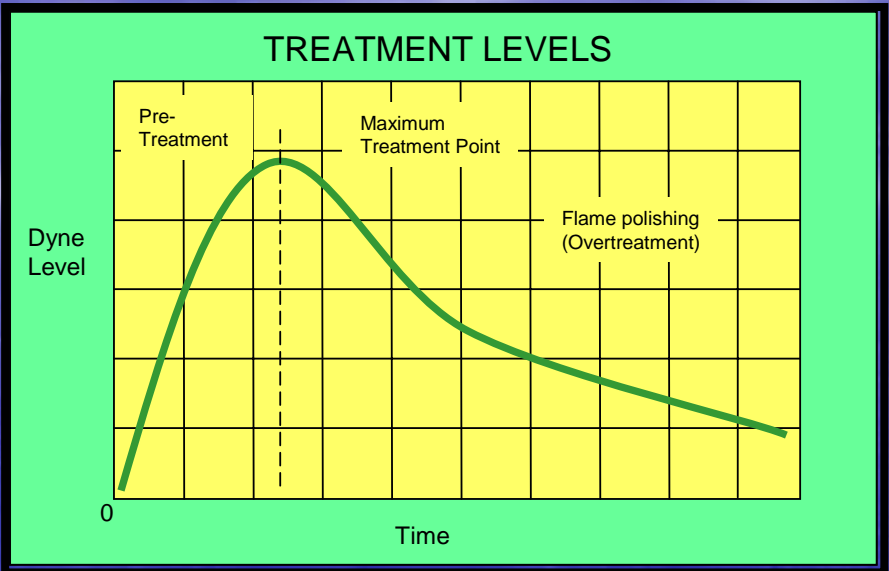
## THE PROCESS

The burners fire onto the high speed web of carton board. Chemical changes occur in the surface of the material. Because the material is moving so fast there is no heat damage or burning.



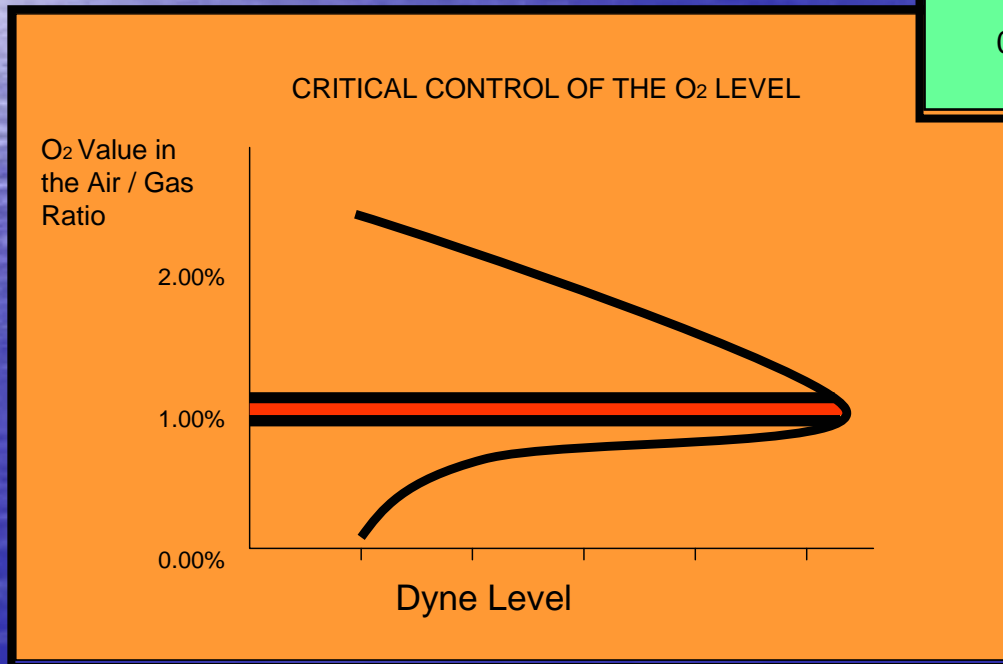
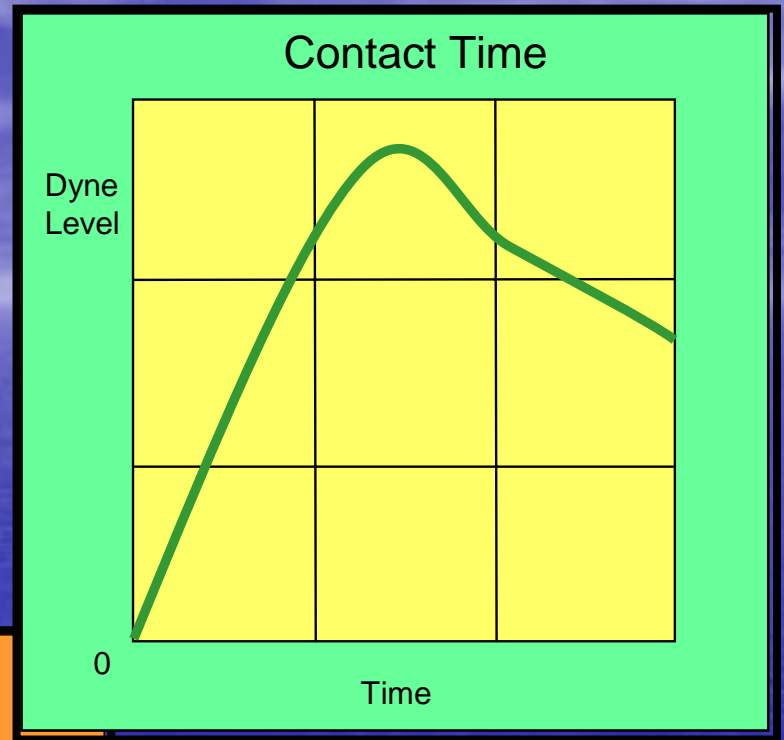
## THE DATA

A carefully controlled flame allows for an activation of the substrate surface. Tuning of the flame allows for optimisation of the treatment on the substrate.



## THE DATA

Crucial parameters such as the air /gas ratio and dwell time allow for controlled tuning of the adhesion improvement on the surface of the material.





## THE CONTROL

### Principle criteria of surface treatment

Crucially tuned parameters to obtain good treatment are as follows.

- **Combustion conditions - Air / Gas ratio**
- **The burner to substrate gap**
- **The dwell time of the substrate in the flame**
- **The substrate**
- **Mechanical handling**
- **Flame energy**

## THE LATEST TECHNOLOGY

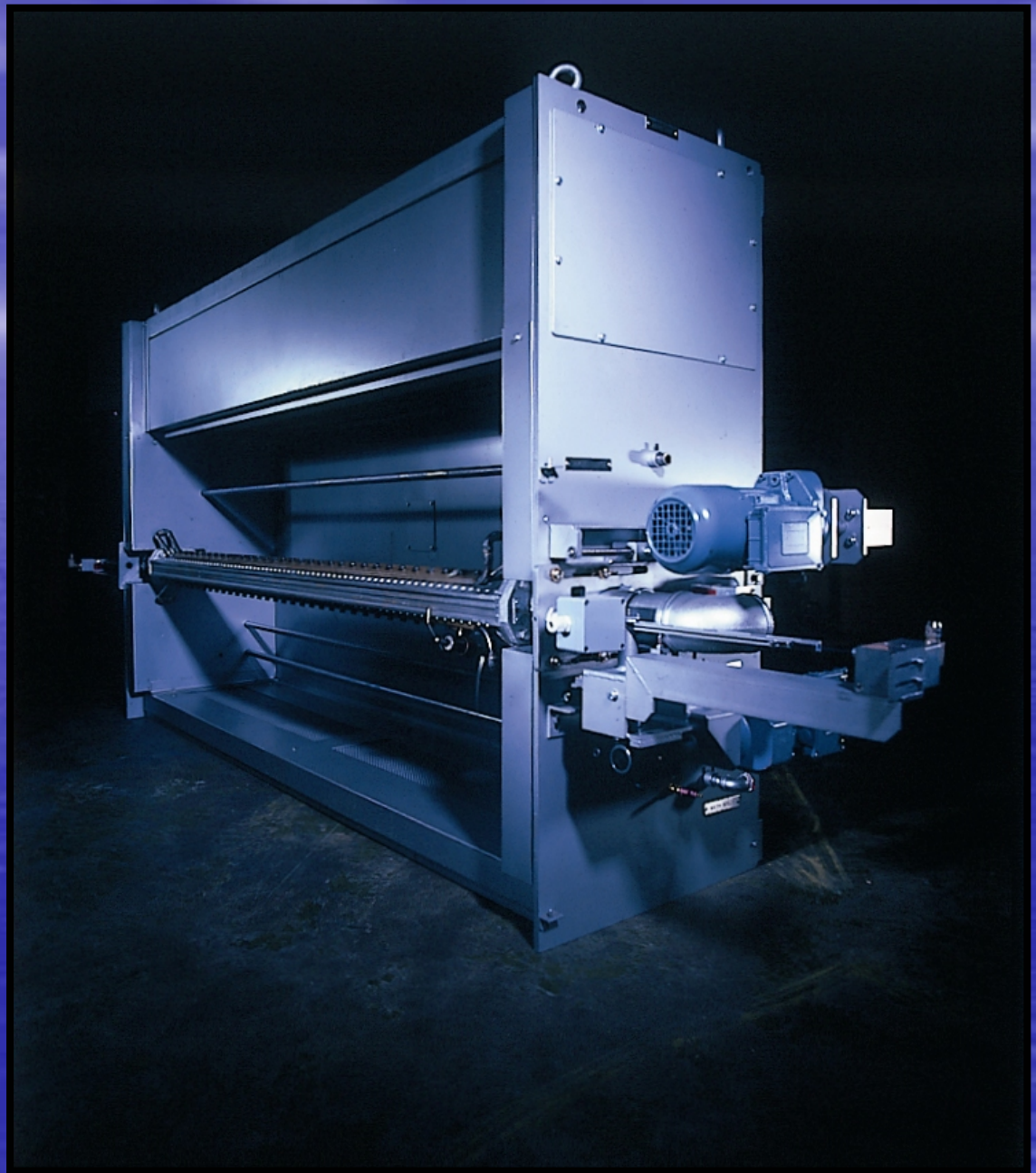
The latest combustion systems incorporate a series of automated controls to refine the treating process. Shows a typical combustion generator.





## THE LATEST TECHNOLOGY

The latest burner hoods incorporate such features as automatic burner positioning relative to web allowing for accurate placement of the flame on the surface of the substrate. Automatic deckling allows for continuous tuning of the flame width giving maximum potential gas saving.



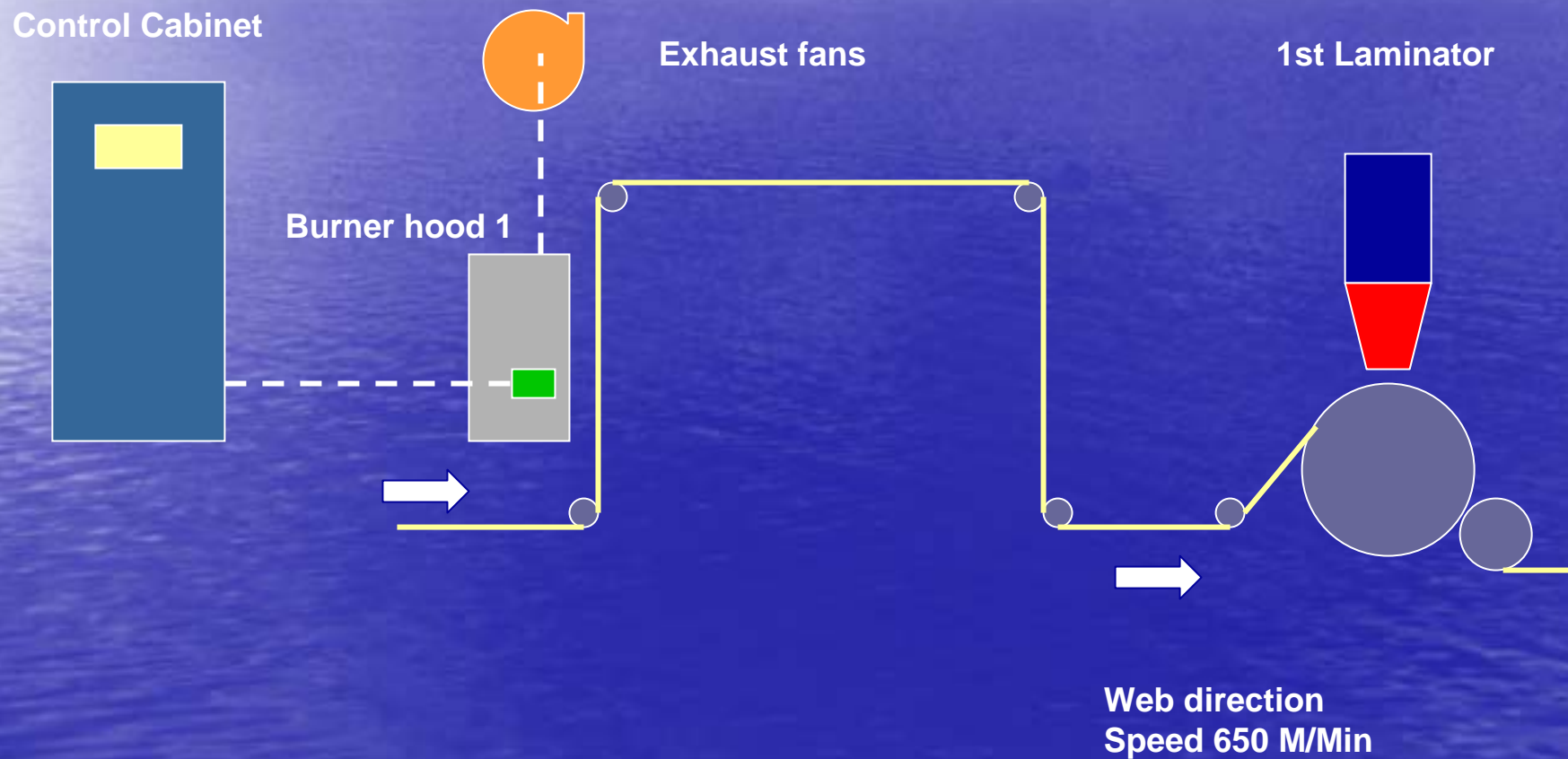


## THE SYSTEM LAYOUT

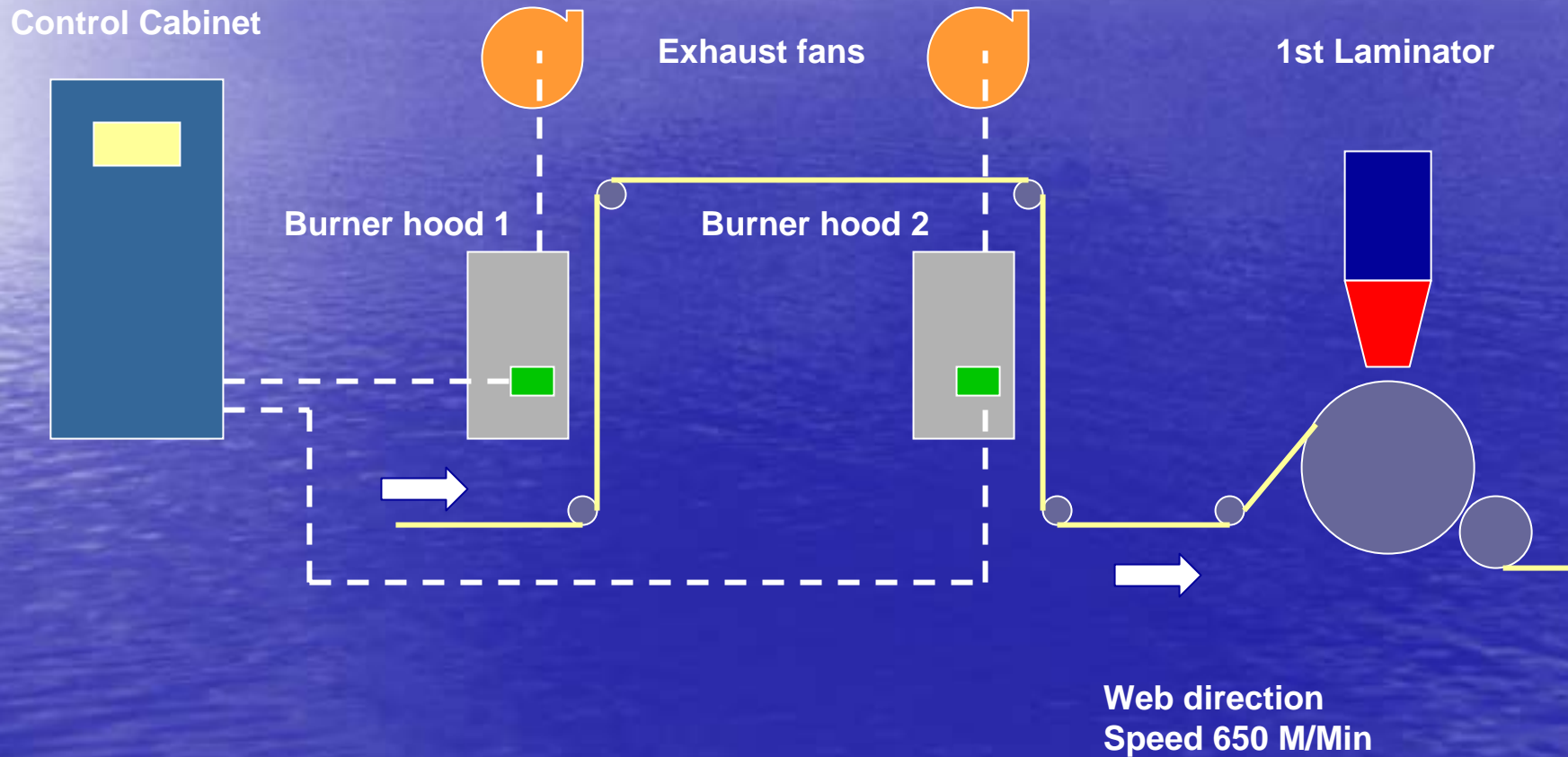
The two burner hoods here are situated in series, firing onto either side of the web.



## SINGLE BURNER PRE-TREATER STATION LAYOUT



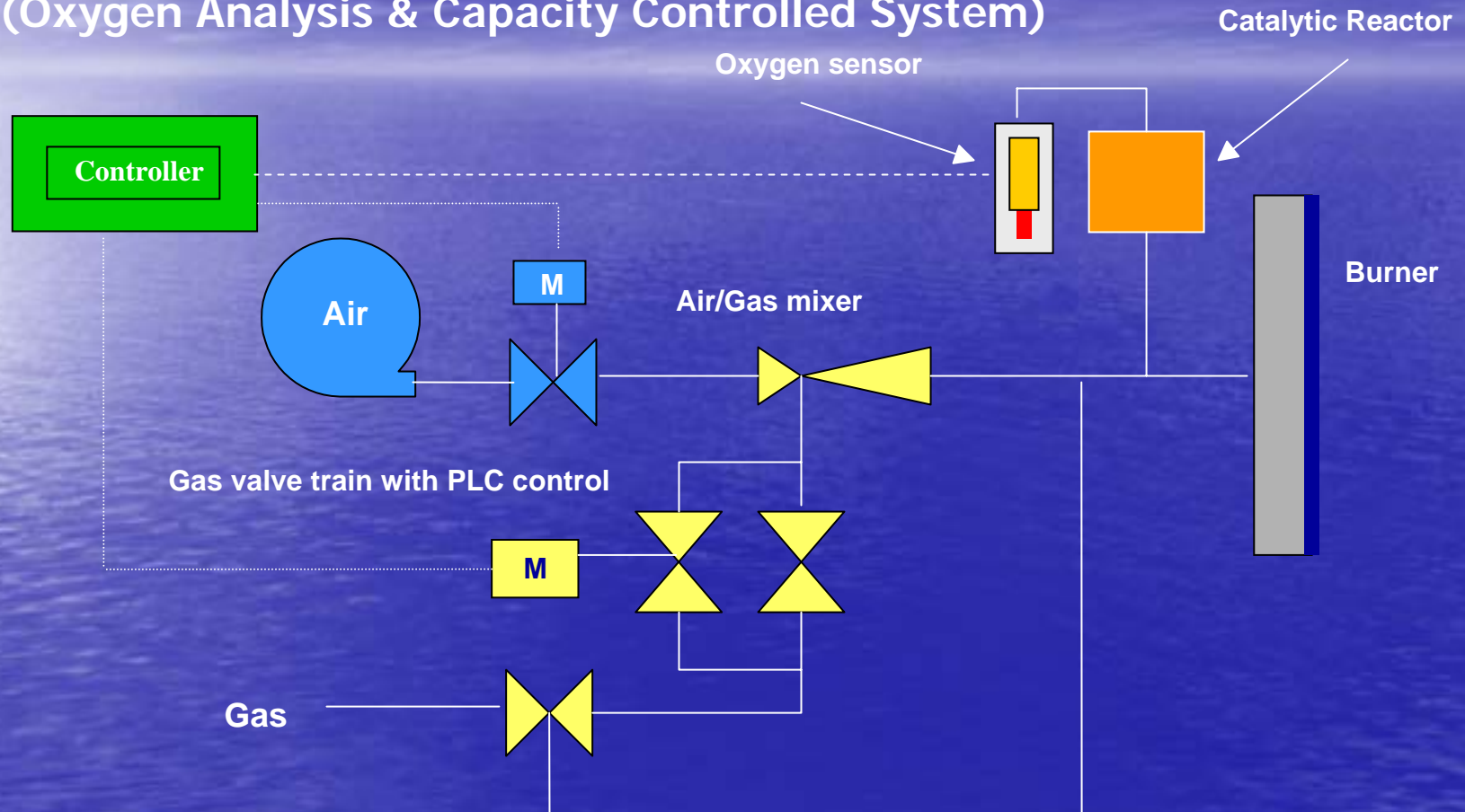
# DOUBLE BURNER PRE-TREATER STATION LAYOUT





# THE VALVE TRAIN LAYOUT

## (Oxygen Analysis & Capacity Controlled System)



The Analyser is far more accurate than flow meters and measure the air gas ratio directly, flow meters try to quantify the air gas ratio but they do it indirectly and cannot automatically compensate

# THE CONTROL INSTRUMENTATION



Oxygen Analyser



Operator Panel

# **GAS SAVING**

**By utilising the latest means of controlling the gas flame, better production results are achieved. There is also the great benefit of reducing gas consumption.**

**Adjusting the flame size relative to the web speed and the flame position of the flame relative to the web allows for the minimal amount of gas to be used**

**Automatic Deckling of the flame ensures the flame is always only as wide as the web**

**Use of the oxygen analyser to optimise the air gas ratio and compensate for any changes in the gas consistency.**



## **THE ADVANTAGES OF FLAME PRE TREATMENT**

**Flame treatment of board - Result**

**Pass 100% fiber tear test**

**No adverse affects**

**No Pin holing of laminate as surface is de - wicked**

**No contamination, such as ozone (smell)**

**No discoloration**

**No V.O.C. Emissions**



## POST TREATMENT OFF FILMS & LAMINATES

Flame Treatment of film and laminates is known as Post Treatment. It is ideal for enhancing the adhesive qualities of substrates such as PP film. The adhesion improvement allows for print, laminate or adhesives to be applied. Products that require flame treatment are Gift wrapping, flower sleeves, textile wrapping, stationary packaging and adhesive tapes.





## THE APPLICATION - FILM

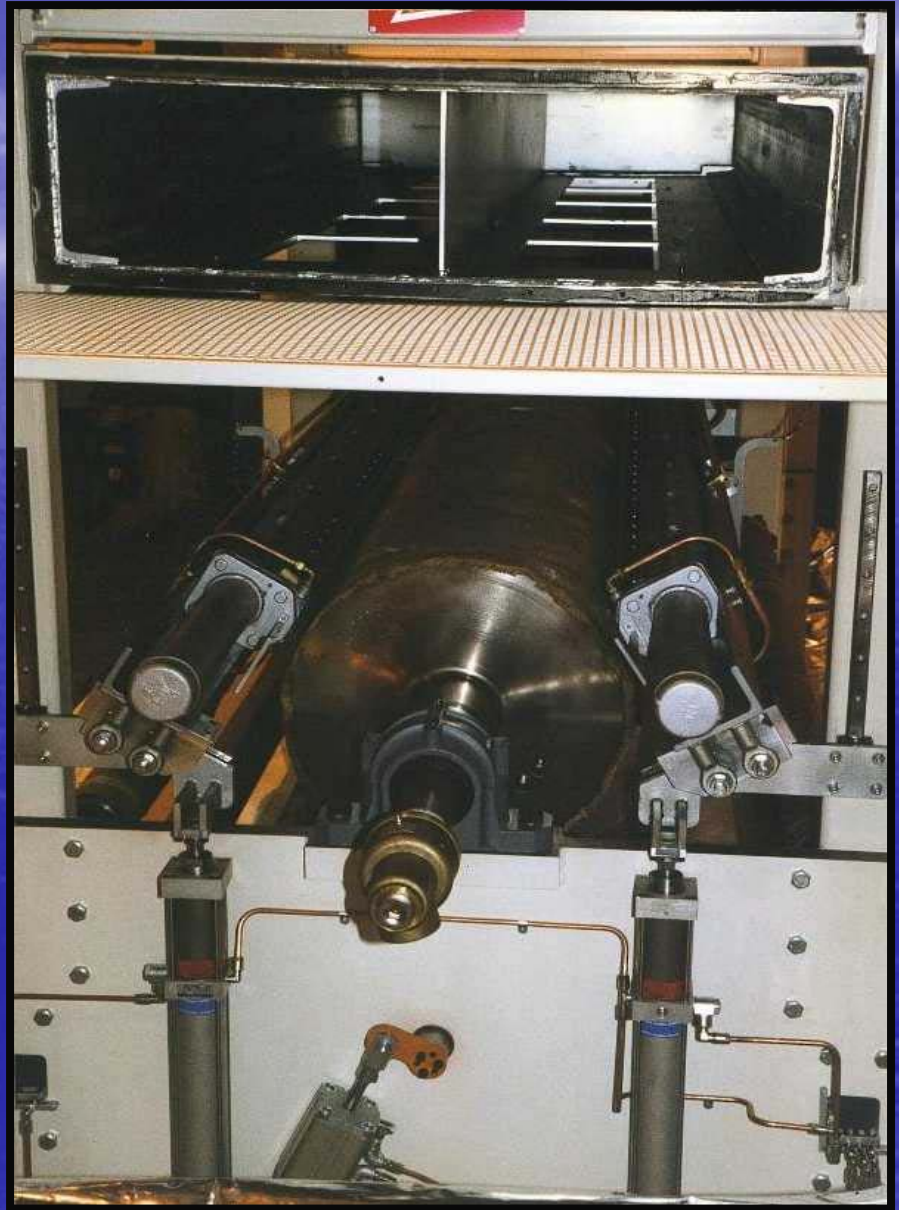
Many substrates in the food packaging industry benefit from the application of flame treatment. Improved adhesion on substrates such as BOPP film are essential to have good print quality. This is of most importance as it is often the label that sells the consumer the product.





## POST TREATING TECHNOLOGY

Typically two burners are required for the POST treatment of a film web. The burners are required to be positioned in series to give a more dispersed gentle application of the flame.



## POST TREATING TECHNOLOGY

Due to the thin nature of film substrates the burners are required to fire onto a water cooled backing roll. Any heat from the flame is dissipated directly through the substrate into the chill roll.





## NEW TECHNOLOGY

Complex burner designs produced for the film industry are now being integrated with systems used for pre treating carton board.

The special modular burner designs to give ease of use and practical maintenance access.



## NEW BURNERS

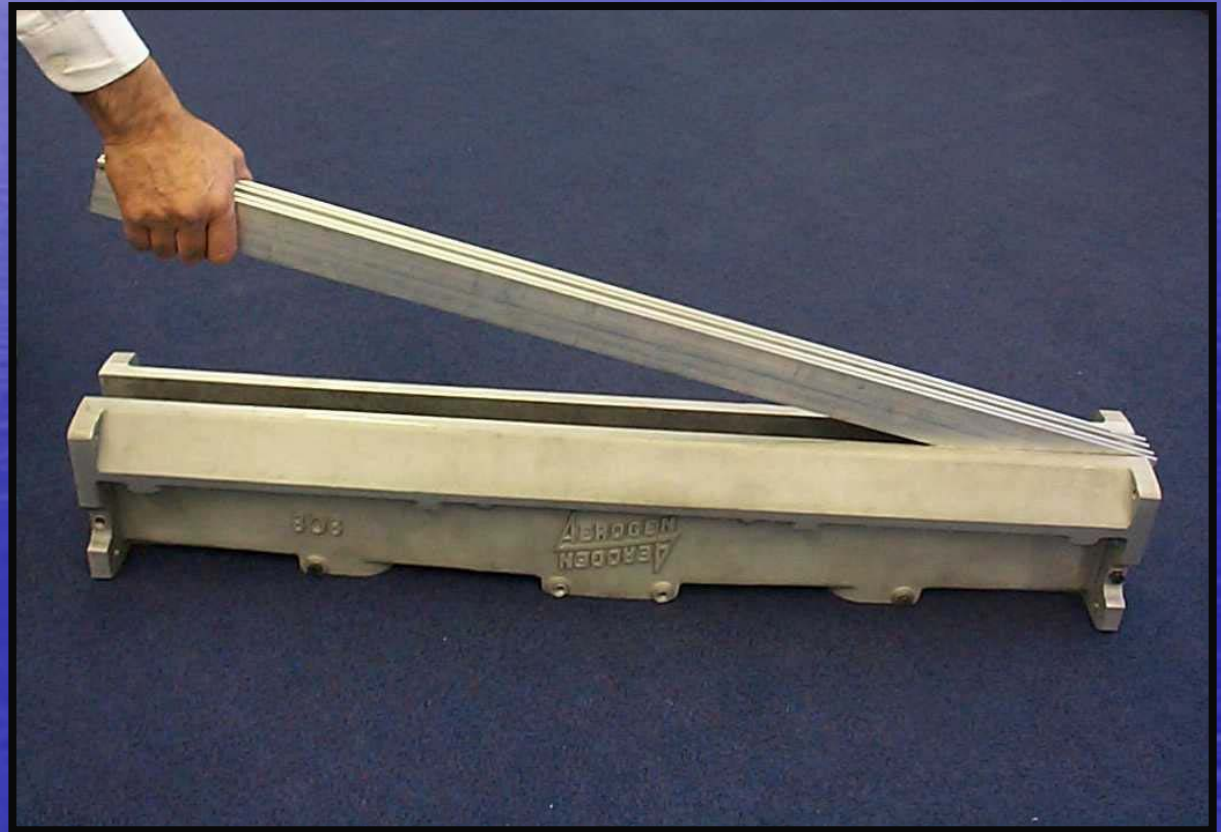
New burners are emerging, innovative designs are being integrated using modular construction.





## NEW BURNERS

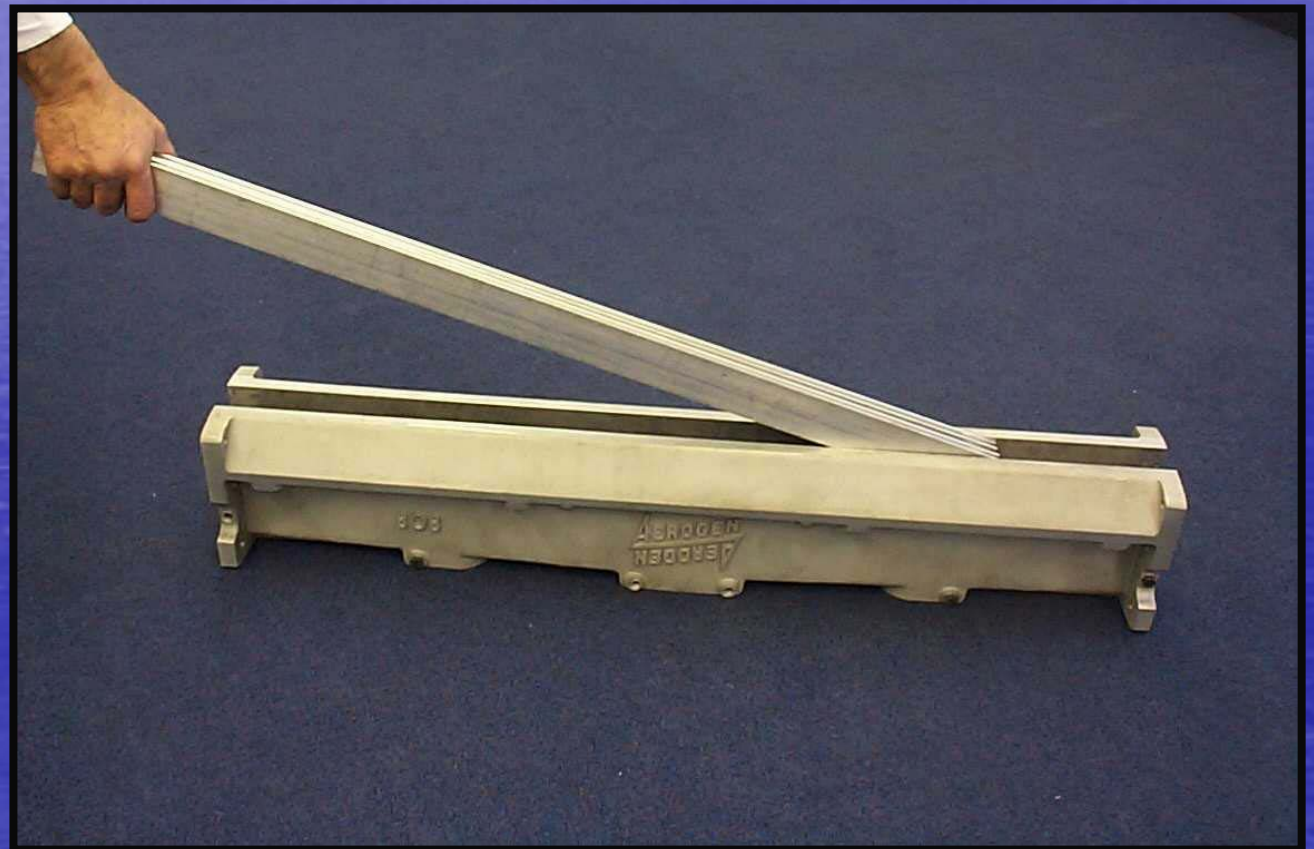
Removable Ribbon burner designs are changing, allowing for maintenance and straight forward flame pattern changes. This is most useful when treating a wide variety of substrates.





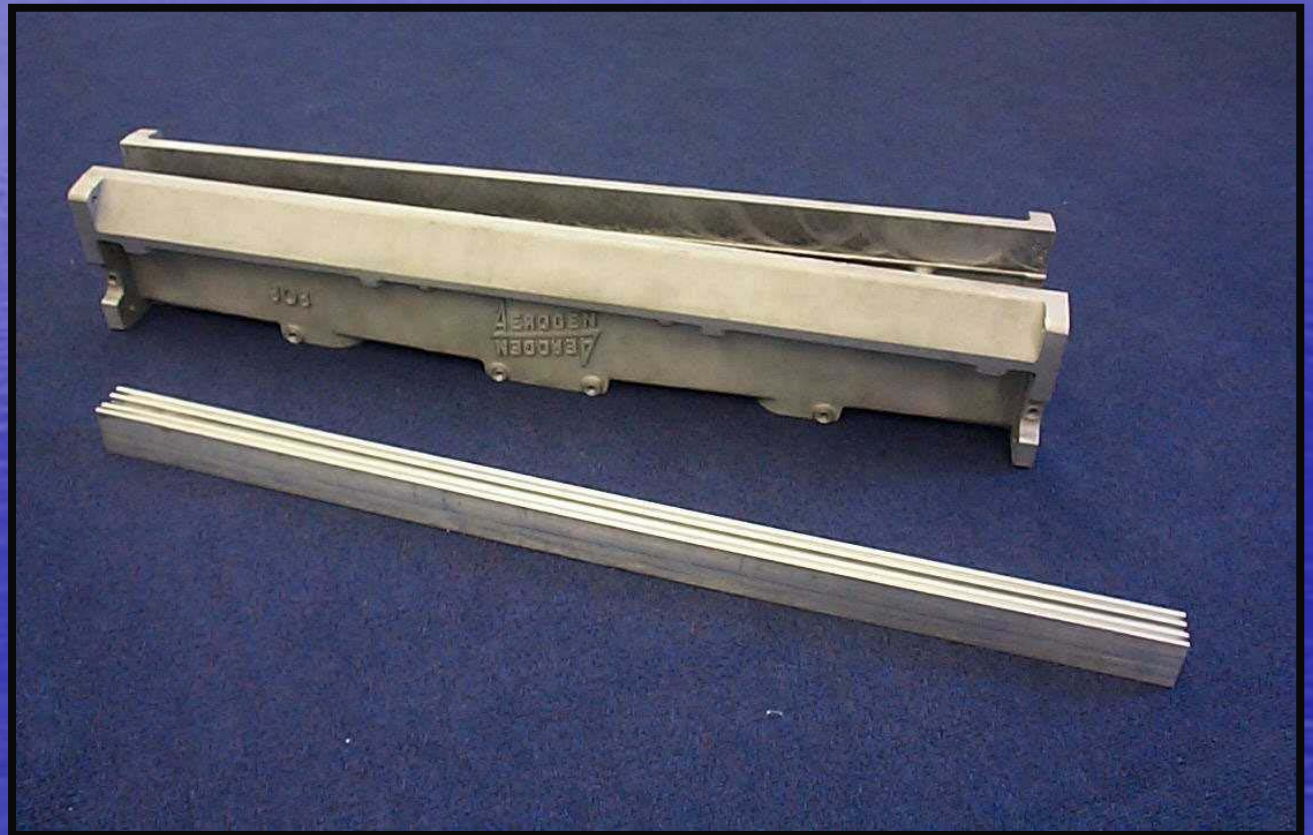
# NEW BURNERS

Modular design



## NEW BURNERS

### Removable Ribbon Pack





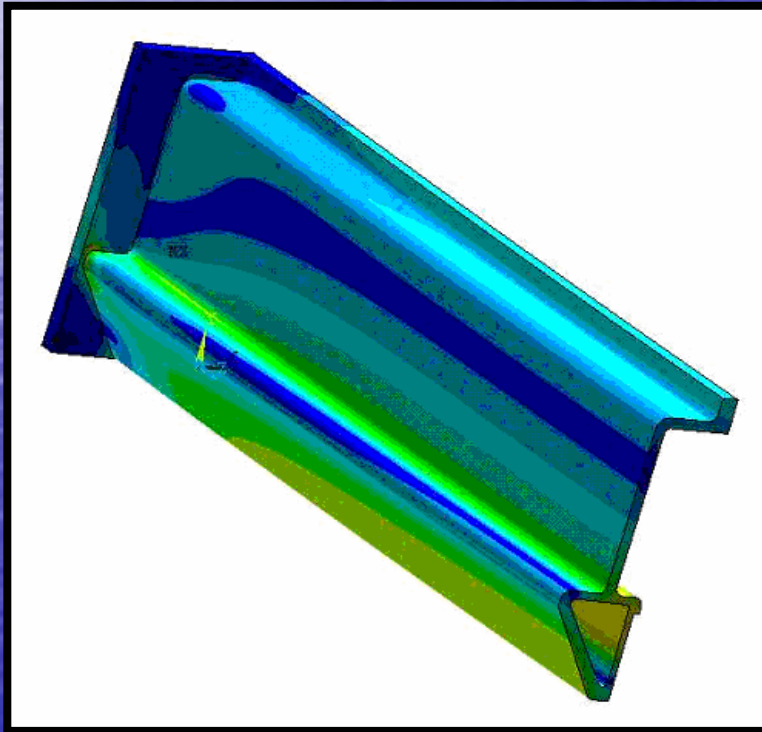
## NEW BURNERS

Modular burner  
bodies.



## NEW BURNERS

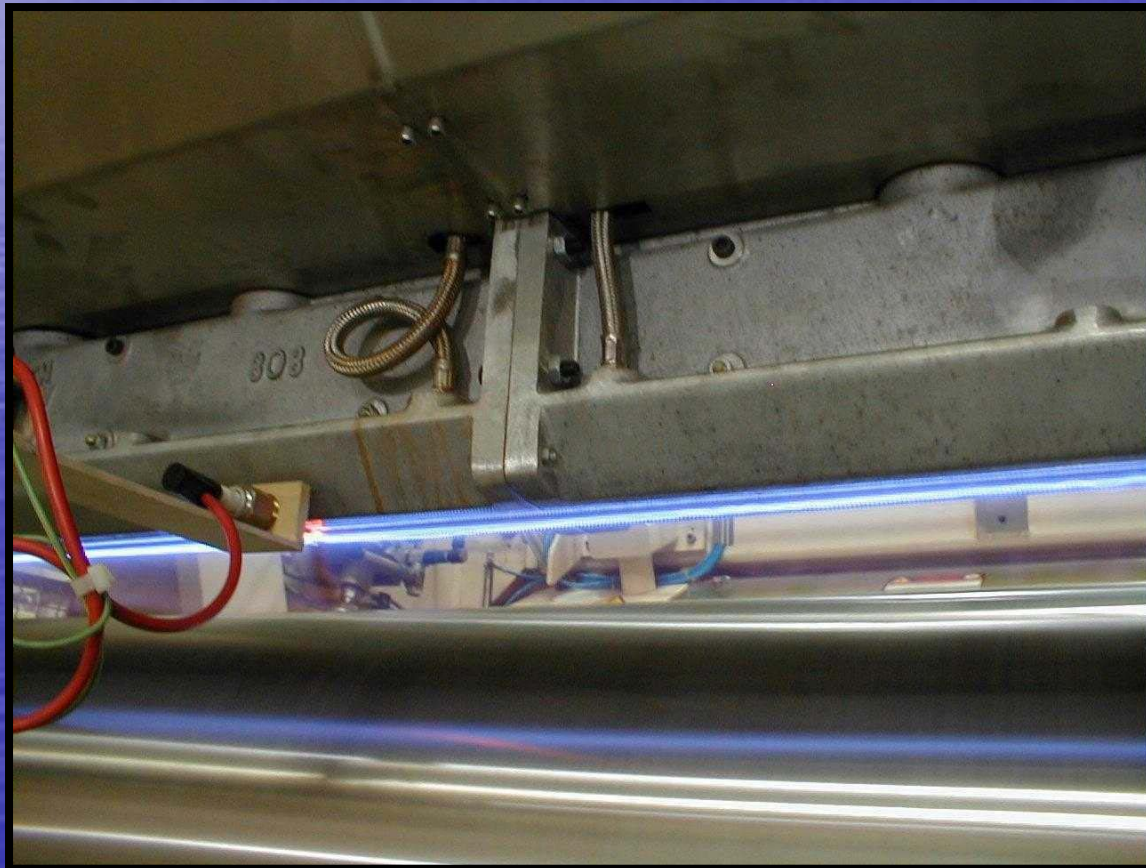
Integral water cooling to give even temperature distribution throughout the burner casting





## MOVING BURNERS

Smooth flame burners produce a very short flame profile. This requires for the positioning of the burner very close to the web. In these instances automatic burner advance and retract controls are used to position the flame once it has ignited.



## **THE ADVANTAGES OF FLAME POST TREATMENT**

### **Flame treatment of Film - Result**

**High Treatment Levels**

**No adverse affects**

**No Pin holing**

**No contamination, such as ozone (smell)**

**No discoloration**

**No V.O.C. Emissions**