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# 用于清洁压榨毛布的化学品

保持压榨毛布清洁对于纸页脱水和纸机生产能力来说至关重要

## Chemical cleaning for press clothing

Keeping press felts clean is critical for dewatering and for  
PM productivity

**毛**布清洁对于纸机能否正常良好运行非常重要，但是随着纸机车速不断稳步提高以及二次纤维用量的不断增加，保持毛布一定的清洁度已经成为一种主要挑战。

要想在更长时间里保持压榨毛布像新毛布一样清洁，可以通过不同方法对其进行化学清洁，这些方法包括：通过停机来对毛布进行间歇式清洁，运行过程中对毛布进行间歇性清洁或者是连续性清洁调整。

The cleanliness of felts is extremely important for the correct functioning of a PM, but with the steady rise in machine speeds and the increase in usage of secondary fibres, maintaining such cleanliness has become a major challenge.

To maintain press felt characteristics in a "like-new" state for a longer period, they can be chemically cleaned

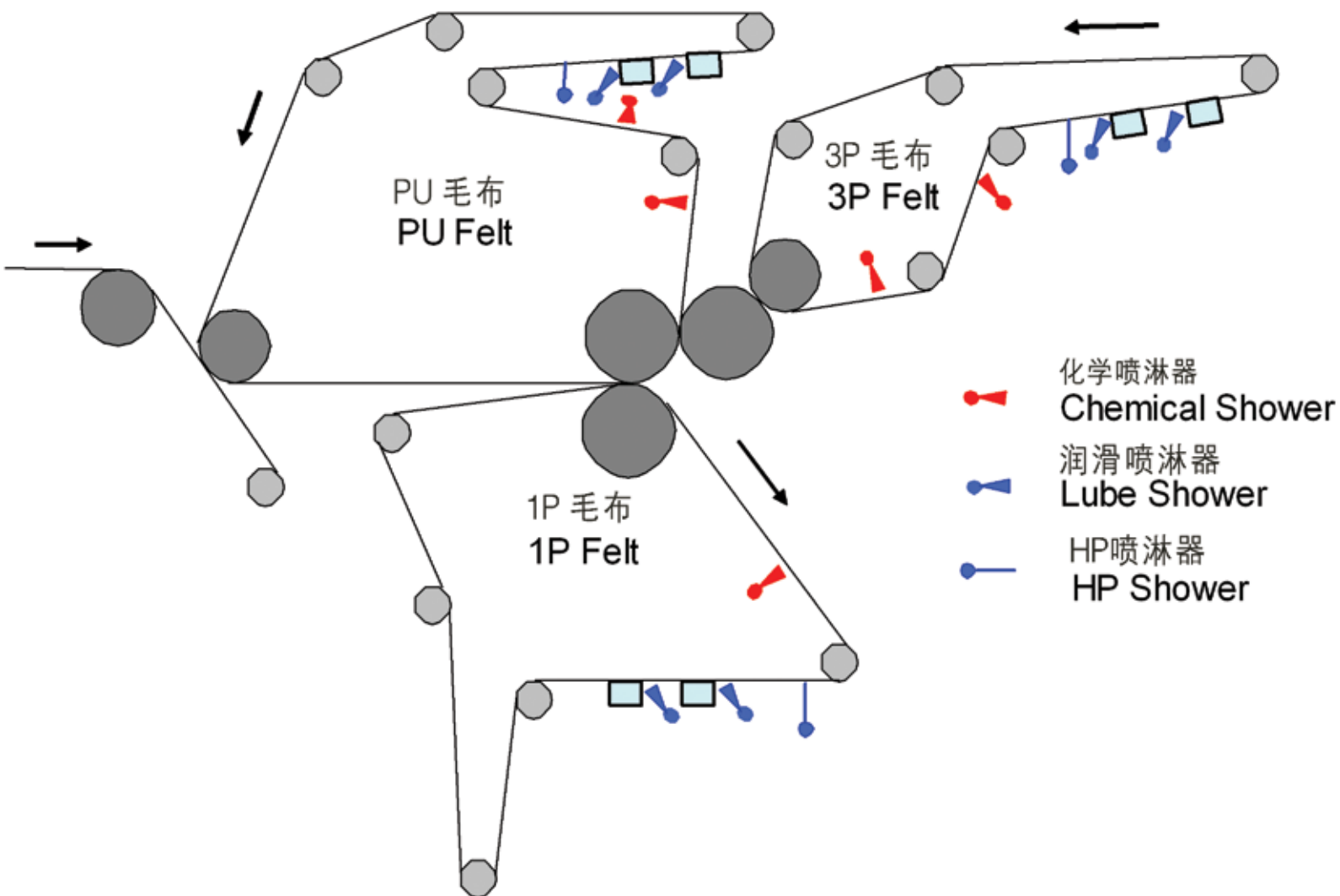


图1：调试化学喷淋杆  
Figure 1: Chemical shower bar set up

目前，纸机运行过程中将连续清洁调整处理和间歇式清洁相结合的方法非常流行，因为这种方法所需的停机时间非常少，因此用于连续生产的时间就多。

然而，为了获得最好的结果，正确选择适合于清洁毛布中污染物的化学品非常重要，并且选择正确的加入位置、合适的加入量以及确保压榨工段所有喷淋装置处于最佳位置也非常重要。

### 支撑、传递和脱水

压榨毛布在压榨工段起着多种功能。当纸页通过每个压榨辊时，毛布起着支撑湿纸页的作用；同时毛布还起着传递纸页到烘干工段的作用；最重要的功能是脱水，通过吸收压区纸页所压出的水来帮助整个纸页脱水。

当纸页中的水被压出来后，它会进入毛布的空隙中。为了获得最大的脱水效果，毛布的空隙面积必须具备接收纸页所脱水的能力，否则当纸页离开压榨区时会产生纸页回湿。

纸页回湿对经济效益和产品质量不利，因为纸页回湿使得进入烘干工段的纸页水分变大，从而使得用于干燥纸页的蒸汽量加大。此外，低干度的纸页强度较差，容易导致断纸。

by various methods including by batch wash down, by batch on the run or by continuous conditioning.

The combination of continuous conditioning and batch on the run is popular because this approach requires less down time and therefore leaves more up time for production.

However, for the optimum result, it is very important to select the correct cleaning product for the type of contaminants in the felts, dose at the correct locations, and ensure that all the showers in the press section are in optimum condition.

### Support, transfer and dewater

The press felts perform several functions in the press section. They support the wet sheet as it passes through each press; they transfer the sheet to the dryer section; and, in one of their most important functions, they help in overall water removal by receiving the water pressed out of the sheet in the press nip.

As the water is pressed out of the wet sheet, it is received into the void area of the felt. To achieve maximum dewatering, the void area must have the capacity to receive this water, otherwise too much rewetting of the sheet will occur as it leaves the press nip.

Rewetting is bad for economics and quality since it results in a wetter sheet entering the dryer section where higher steam

## 随着纸机车速的不断提高以及二次纤维用量的不断增加，保持毛布清洁度已经成为一种主要挑战

### Felt maintenance has become a major challenge with rising PM speeds and the increasing usage of secondary fibres and additives

尽管不能避免毛布空隙填充作用，但是随着毛布使用时间的延长，空隙填充速率可以延缓。这将尽可能的确保毛布保持一定的脱水能力。

压榨毛布的另外一个关键要素是均一渗透性。如果没有这一要求，湿度条纹将会影响成纸质量。均一渗透性能够转化成均一的横向脱水，不均匀的横向渗透性导致不均匀的脱水，这是因为毛布中渗透性好的地方空气就易于穿过。空气穿透性越好脱水效率越高。

要想延缓压榨毛布空隙的填充速度以及保持毛布具备均一的横向渗透性，必须确保压榨毛布不能受到污染物污染，比如一些不溶性固体残余物会导致纸页表面局部破损、产生针孔和掉毛现象。

然而，虽然不能够避免细小纤维和填料在毛布中发生堆积，但是可以延缓这一过程以便保持毛布在使用时具备一定的渗透性。

在压榨区脱水工段中，系统中的污染物被带入纸页中从而传递到压榨毛布中。随着纸机车速的增加以及二次纤维和填料用量的不断增加，这种问题已经变得非常严重。

在这些条件下，毛布清洁对于保持良好的纸机运行性能、生产能力以及产品质量变得尤为重要。

consumption is required to dry the sheet. Moreover, a sheet with low dryness is a weaker sheet and this can result in sheet breaks.

Though the filling of the void area cannot be avoided, the rate of filling must be retarded as the felt ages. This will ensure that the dewatering capability of the felt is maintained as long as possible.

Another key requirement of the press felt is uniform permeability. Without this, moisture streaks will impair the quality of the sheet. Uniform permeability translates into uniform CD dewatering and uneven CD permeability into uneven dewatering. This is because the air flow through the felt tends to be greater at the area where permeability is higher. The higher the air flow the better the dewatering,

To retard the rate of filling of the press felt void area and to maintain a uniform CD permeability, the press felt must be free from contaminants such as the insoluble solid residues that can lead to localised crushing, pinholes, and picking of the surface fibres from the sheet.

While the build up of fine and filler in the felt cannot be avoided, it should be retarded to maintain the permeability of the felts for as long as the felts are in use.

Contaminants from the system get into the sheet and are transferred to the press felts during the dewatering process in the press nip. This problem has become more critical with the increase in paper machine speed and with the increased use of secondary fibres and additives.

In these conditions, the cleaning of the press felt becomes critically important for good paper machine runnability, productivity and quality.

#### Cleaning and conditioning mechanisms

The main purpose of cleaning and conditioning the felts is to prevent them from being filled and contaminated quickly, thereby maintaining their dewatering capability for as long as possible. In the case of a slow machine, this may even be interpreted as an increase in felt life.

The cleaner and conditioner used on the press felts must be able to deal with the contaminants that are usually an accumulation of one or more of the following four categories:

图2：每日生产趋势  
Figure 2: Daily production trend

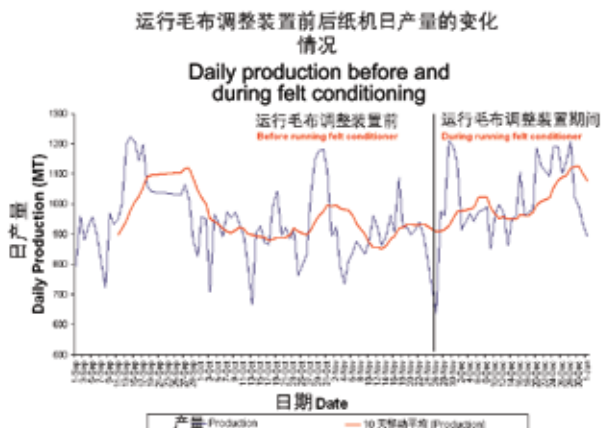






图3: 日常断纸总数的趋势  
Figure 3: Total daily paper break trend

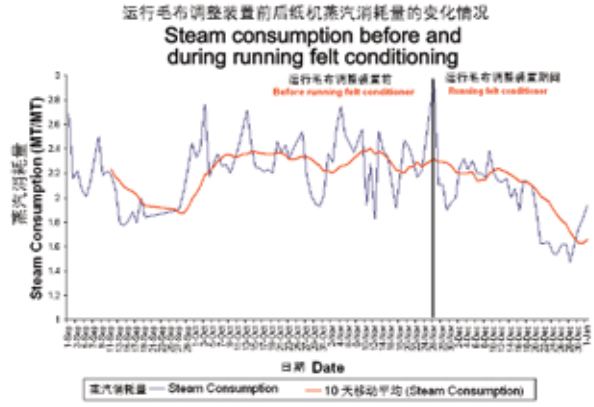


图4: 每日生产每吨纸所消耗蒸汽量的趋势  
Figure 4: Daily steam consumption per ton of paper produced trend

### 清洁和调整处理机理

毛布清洁和调整处理的主要目的是防止毛布被快速填充和污染,从而尽可能地保持一定的脱水能力。对于低速纸机来说,这可以解释为提高毛布的使用寿命。

用于清洁压榨毛布的清洁剂和调整处理设备必须能够处理污染物,这些污染物通常包括以下四种中的一种或多种:

一、二次纤维: 沥青; 胶乳; 蜡; 粘合剂; 热溶物

二、天然木材树脂

三、浆料和液体添加剂: 消泡剂; 施胶剂; 淀粉; 胶乳; 填料, 比如碳酸钙、二氧化钛和瓷土; 助留助滤剂

四、无机沉淀物: 碳酸钙和硫酸钡

一般情况下,用于清洁压榨毛布的清洁设备和调整处理设备常采用乳化、溶解、分散、润湿和螯合四种不同机理。

乳化: 表面活性剂将所捕捉的有机物质带进水相,从而使其能够被冲洗掉。

溶解: 碱性或酸性溶剂被用于溶解固体和液体污染物。表面活性剂被用于加速该过程。

分散: 使用阴离子分散剂来加强污染物的表面电荷,从而使它们排斥带负电荷的织物表面。

**如果毛布吸收从纸页压榨出来的水的能力减弱,那么当纸页离开压榨区时会产生纸页回湿**

- i) Secondary fibres: Asphalt; Latex; Wax; Adhesive; Hot melts
- ii) Natural wood pitch
- iii) Stock and water additives: Defoamer; size; starch; latex; filler such as calcium carbonate (CaCO<sub>3</sub>), titanium dioxide (TiO<sub>2</sub>) and aluminum silicate (Clay); retention and drainage aids
- iv) Inorganic precipitates: Calcium carbonate and Barium sulphate

In general, the cleaners and conditioners used on the press felts use a variety of mechanisms including emulsification, solubilisation, dispersion, wetting and chelating.

Emulsification: Surfactants trap organic materials into the water phase where they can be flushed away.

Solubilisation: Caustic or acid solvents are used to dissolve solid and liquid contaminants. Surfactants are used to speed up this process.

Dispersion: Anionic dispersants are used to enhance the surface charge of contaminants, thus causing them to repel the negatively charged fabric surface.

Wetting: Surfactants added to the shower water reduce the surface tension of the water and this helps the felt absorb and release water more easily.

Chelating/Sequestration: To improve product performance, special chemicals are used to tie up hard water species such as Al<sup>3+</sup>, Ca<sup>2+</sup> and Mg<sup>2+</sup>

### Selection and application

To select the correct cleaner for the press felts, it is first necessary to identify the type of contaminant, because different cleaners are designed to deal with contaminants of different compositions.

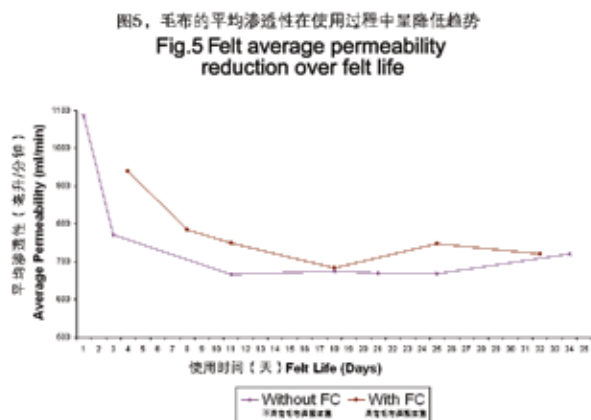


图5: 毛布平均渗透性在整个使用周期中逐渐降低  
Figure 5: Average permeability reduction over felt life

润湿: 表面活性剂被加入到喷淋水中用于降低水的表面张力, 从而有助于毛布吸收和水分释放。

A felt analysis is therefore essential before choosing the cleaner. When the old felt is off the machine, a sample of the felt should be analysed to determine the composition of the contaminants in the felt. Based on the results from the analysis, an appropriate cleaner is selected.

Out of the three methods of cleaning press felts, batch cleaning is usually conducted during a paper machine outage. This cleaning method will incur down time on the paper machine and result in loss of production.

Continuous cleaning or felt conditioning is carried out continuously. This method removes built-up contaminants with proper cleaning chemistry to keep the press felts in their original, "broken in" condition throughout their useful lives.

Cleaning on the run or batch on the run is carried out with the paper machine running full speed and in production. This method is becoming popular as the press felts can be cleaned during production and unnecessary down time is reduced.

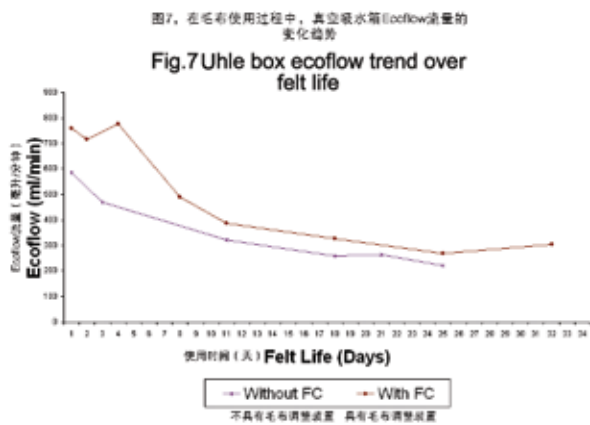


图7：真空吸水箱在整个毛布使用周期中的Ecoflow流量的趋势  
Figure 7: Uhle box Ecoflow trend over felt life

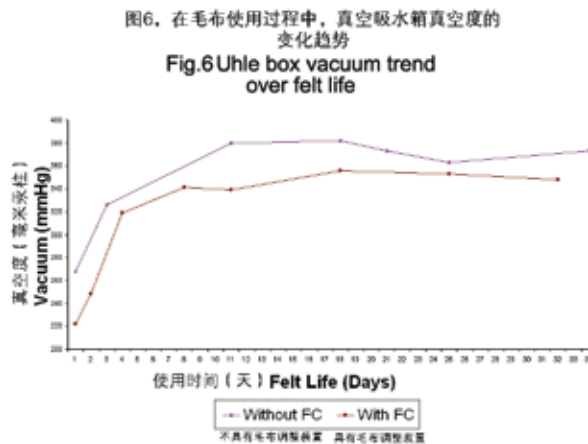


图6：真空吸水箱真空度在整个毛布使用周期中的趋势  
Figure 6: Uhle box vacuum trend over felt life

螯合/隔离：为了提高产品质量，一些特殊化学品被用于对硬水中的元素，如Al<sup>3+</sup>、Ca<sup>2+</sup>和Mg<sup>2+</sup>进行螯合或隔离。

### 选择与应用

要想正确选择适合于压榨毛布清洁的清洁剂，首先必须对污染物类型进行鉴别，因为不同清洁剂被设计用于处理不同组分的污染物。

因此在选择清洁装置之前，对毛布进行分析非常有必要。当旧毛布从纸机上拆卸下来后，应该对毛布样本进行分析，从而确定毛布中污染物的成分。基于最终分析结果，然后选择合适的清洁剂。

在三种压榨毛布清洁方法当中，间隙式清洁通常在纸机停机时采用。这种清洁方法导致纸机存在停机时间，从而造成生产损失。

连续式清洁或毛布调整处理是采用连续的方式进行的。该方法采用合适的清洁剂来去除堆积在毛布中的污染物，从而在整个使用周期中保持压榨毛布处于最初状态。

运行过程中连续清洁或者间歇式清洁都是在纸机处于全速运行、满负荷生产状态下进行的。这种方法正越来越受欢迎，这是因为压榨毛布能够在生产过程得以清洁，从而大大降低了不必要的停机时间。

For the best cleaning result, the combination of felt conditioning and batch wash or batch on the run is recommended. The later combination is the more popular choice today, since it reduces the down time required for the batch wash, resulting in more up time for production.

### Points of addition and dosage

When setting up the chemical shower bar for felt cleaning, it is important to consider the dwell time required for the cleaner to work and the mechanical means to help the cleaner to penetrate the felt to deal with the contamination.

Figure 1 shows the most appropriate locations for the chemical shower bar that applies the cleaner for batch wash, conditioning and batch on the run.

All the chemical shower bar locations provide sufficient dwell time for the cleaner and are before the in-going nip of a felt roll.

为了使压榨毛布获得很好化学处理效果，压榨工段所有的喷淋设备必须处于最佳位置

To run a good chemical treatment programme on the press felts, all the showers in the press section have to be in optimum condition

## 不均一的毛布渗透性会导致不均一的脱水，从而在纸页横向产生湿度条纹

为了达到最好的清洁效果，一般推荐将毛布清洁调整处理和间歇式冲洗或运行过程中间隙清洁相结合的方法。后一种结合法在当今更为流行，因为该方法能够大大减少用于间歇式冲洗的停机时间，从而无形当中增加了用于生产的时间。

### 加入点和用量

当安装用于清洁毛布的化学品喷淋杆时，必须考虑清洁剂充分作用所需要的停留时间，以及有助于清洁剂向毛布渗透进而有效处理污染物的机械手段。

图1表示了化学品喷淋杆最合适的位置，该喷淋杆提供用于间歇冲洗、调节和运行过程中间隙清洁的清洁剂。

所有化学品喷淋杆的位置都能够提供充足的清洁剂停留时间，并且它们都位于毛布压榨辊压区之前。

为了确保化学品充分混合，清洁剂进入化学喷淋杆的喷射点必须距离喷淋杆至少2米，如果距离小于2米，必须安装用于充分混合的静态混合器。

根据毛布的污染程度来选择清洁剂的加入量。如前面所述，在压榨脱水过程中，来源于纸页中的污染物被转移到毛布中。转移的水越多，向毛布中渗透的污染物就越多。由于图1中PU毛布是第一次与湿纸页接触，它处理水的能力要比1P和3P毛布要强，因此它所产生的污染物也是最多的，其次是1P毛布，3P毛布所含的污染物最少。

### 监测与评价

对压榨毛布执行化学品处理方案的最终目的是为了保持毛布的清洁度和脱水能力，从而能够获得更好纸机运行性能、更高的生产效率和产品质量。

用于正确监测连续性清洁方案有效性的常用参数是：纸机车速、生产规模(图2)、断纸次数(图3)、生产每吨成品纸的蒸汽消耗量(图4)、毛布寿命、纸病和用于毛布清洁的停机时间。

间接的监测参数是：毛布的渗透性(图5)、真空吸水箱的真空度(图6)、真空吸水箱的水流量(图7)、真空吸水箱的空气流量、毛布湿度和纸页湿度分布。

对于间歇式冲洗和运行过程中的间隙清洁来说，毛布渗透性应该在清洁前后分别进行测量，以便于进行比较(图8)。真空吸水箱的真空度也应该用这种方法进行测量。经过间歇式冲洗和运行过程中间隙清洁的真空吸水箱真空度应该会变得变小，因为毛布变得干净了。

To ensure proper mixing, the injection point of the cleaner into the chemical shower bar should be at least 2m from the shower bar. If the distance is less than 2m, it may be necessary to install a static mixer for proper mixing.

The dosages of the selected cleaner are based on the severity of the contamination of the felts. As mentioned previously, the contaminants from the sheet are transferred to the felt during dewatering in the press nip. The more water is transferred, the more contaminants are being transferred to the felt. Since the PU felt in figure 1 is the first felt which is in contact with the wet sheet, it handles more water than the 1P and 3P felts, hence it is generally the most contaminated felt, followed by the 1P felt. The 3P has the least contamination.

### Monitoring and evaluation

The ultimate reason for implementing a chemical treatment programme for the press felts is to maintain the felt's cleanliness and dewatering capability in order to achieve better runnability, better productivity and better quality.

The common parameters used for the direct monitoring of the effectiveness of the continuous cleaning programme, are machine speed, production (figure 2), number of sheet breaks (figure 3), steam consumption per ton of paper produced (figure 4), felt life, sheet defects and the down time for cleaning.

The indirect monitoring parameters are the felt permeability (figure 5), the uhle boxes vacuum (figure 6), the uhle boxes water flow (figure 7), the uhle boxes air flow, the felt moisture and the sheet moisture profile.

For batch wash and batch on the run treatments, felt permeability should be measured before and after for comparison (figure 8). The uhle box vacuum should also be measured in this way. The vacuum of the uhle boxes should be lower after the batch wash or the batch on the run is performed, as the felt is cleaner.

### Other considerations

To run a good chemical treatment on the press felts, all the showers in the press section have to be in optimum condition.

The function of press showering is to lubricate and clean the felt. Without a proper showering system, the full benefits of chemical treatment will not be obtained. Indeed, in such circumstances, chemical treatment will make the condition of the felt worst, resulting in negative impacts on PM runnability, productivity and quality.

It is therefore very important to make sure that the lube shower has good coverage and that the HP shower oscillation is correct at 1mm per revolution of the felt. The HP shower

## 在线清洁前后第一个顶部毛布渗透性的变化 Comparison of 1st top felt permeability before and after online cleaning

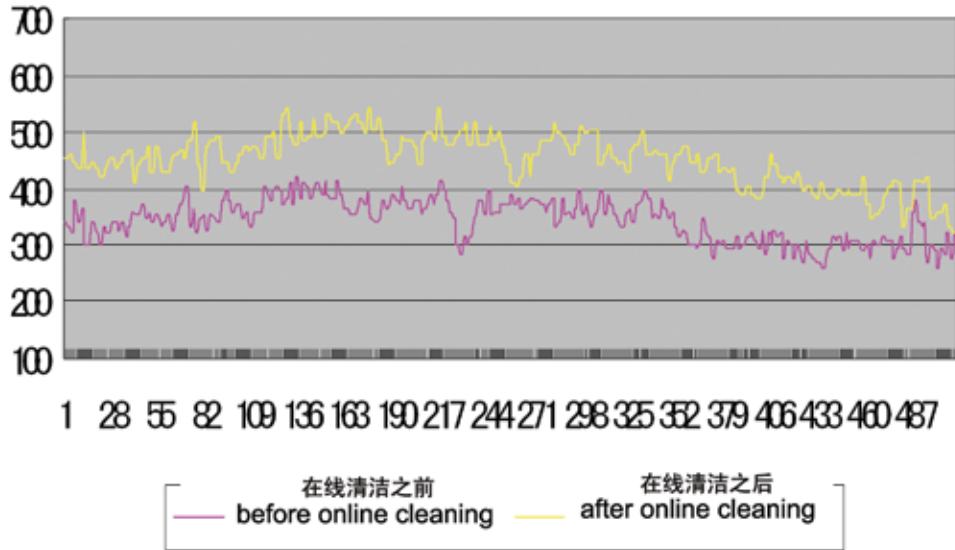


图8: 运行过程中间歇清洁前后毛布的横向渗透性  
Figure 8: CD felt permeability before and after batch on the run

### 其它需要考虑的事项

为了使压榨毛布获得很好化学处理效果，压榨工段所有的喷淋设备必须处于最佳位置。

压力喷淋的作用是润滑和清洁毛布。如果不具备适当的喷淋系统，就无法充分获得很好的化学处理效果。实际上，在这种环境中化学处理将使得毛布的条件变得更加恶劣，从而对纸机运行性能、生产效率和产品质量产生负面影响。

因此，确保润滑喷淋设备具备很好的覆盖面以及确保毛布每旋转一次时HP喷淋器振动1毫米尤为重要。HP喷淋器必须具备两倍的覆盖效果，这意味着行程长度必须是HP喷淋杆上喷嘴到喷嘴之间距离的两倍。化学喷淋器必须具备均一的覆盖面，最好能够两倍覆盖，这样的话，如果有一个喷嘴被堵塞了，也能够保持较好的全面覆盖效果。

### 化学清洁的好处

运用化学清洁能够通过很多不同途径来提高毛布性能。第一，它可以降低毛布平均渗透性的损失比率来提高毛布的性能。第二，它可以降低毛布脱水能力的损失率来提高毛布的性能。最后，它可以降低毛布孔隙的填充速度来提高毛布的性能，这可以通过在毛布使用周期中真空吸水箱真空度增加较慢来加以说明。

对毛布进行适当的化学清洁，最直接的好处包括：提高生产效率、提高纸机运行性能、减少断纸、减少生产每吨纸的蒸汽消耗量。蒸汽消耗量的减少能够为那些受蒸汽限制的纸机提供提高车速的机会。

由亚马逊化学品公司应用支持专员Wilson Lee撰写

must also have double coverage, which means that the stroke length must be double the nozzle-to-nozzle distance on the HP shower bar. The chemical shower must have good and even coverage preferably with double coverage, so that if one nozzle is plugged, there is still full coverage.

### Benefits of chemical cleaning

The chemical cleaning application can improve felt in a number of ways. Firstly, it can slow down the rate of reduction of the average permeability of the felt. Secondly, it can slow down the rate of reduction of the water handling capability of the felt. Finally, it can slow down the rate of filling, which is indicated by a slower increase in the uhle box vacuum over the life of the felt.

With a proper felt chemical cleaning application, direct benefits can include higher production, better machine runnability, fewer breaks, and lower steam consumption per ton of paper produced. The reduction in steam consumption gives a mill the opportunity to increase the speed of a steam limited paper machine. ■

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