Designing and Operating Wringer Rolls
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THE PROBLEM

Wringing fluids properly is a vital part of metal processing and should be done correctly and to the highest standards. Poor wringing can lead to high material costs and increased usage due to inconsistent fluid control and high quantities of material waste. There are two main considerations when installing an NCCM® wringer roll. First, one must consider proper design and product selection. Secondly, one must consider correct operation and application parameters. The advantages of installing an NCCM® wringer roll are as follows:

- Less downtime
- Lower chemical costs
- Increased roll life
- Lower energy usage

NCCM® Premier Yellow Nonwoven Roll

To ensure maximum potential of these qualities, the NCCM® wringer roll must be engineered, installed and operated correctly. Since each application is different, it is critical to install the proper NCCM® product for the application desired. It is also important that the correct size, density and key configurations are installed to ensure the roll runs properly and has maximum life and value. Finally, the roll needs to be operated correctly to ensure the best quality product and longest roll life are obtained.

PROPER DESIGN

<u>Fluid Type:</u> When designing a wringer roll, it is critical to know what type of fluid the product will be wringing as knowing this will determine the proper product selection. However, it isn't enough to only

know the type of fluid; it is also important to know the pH and the temperature of the fluid as well. If the pH exceeds the range of 2-10 pH, then a NCCM® CX-Series product should be used.

You can also determine what density is needed depending on the operating temperature. A higher temperature operation will require a higher density roll.

Machine Capabilities: When designing a wringer roll, it is also important to take into consideration the machine settings. If the temperature requires a certain roll density, the machine needs to be able to provide the correct amount of pressure to achieve the correct nip. We have seen cases in which a roll was designed to perform at a certain pressure, but the machine it was running on lacked the capacity to apply that pressure. This resulted in product failure.

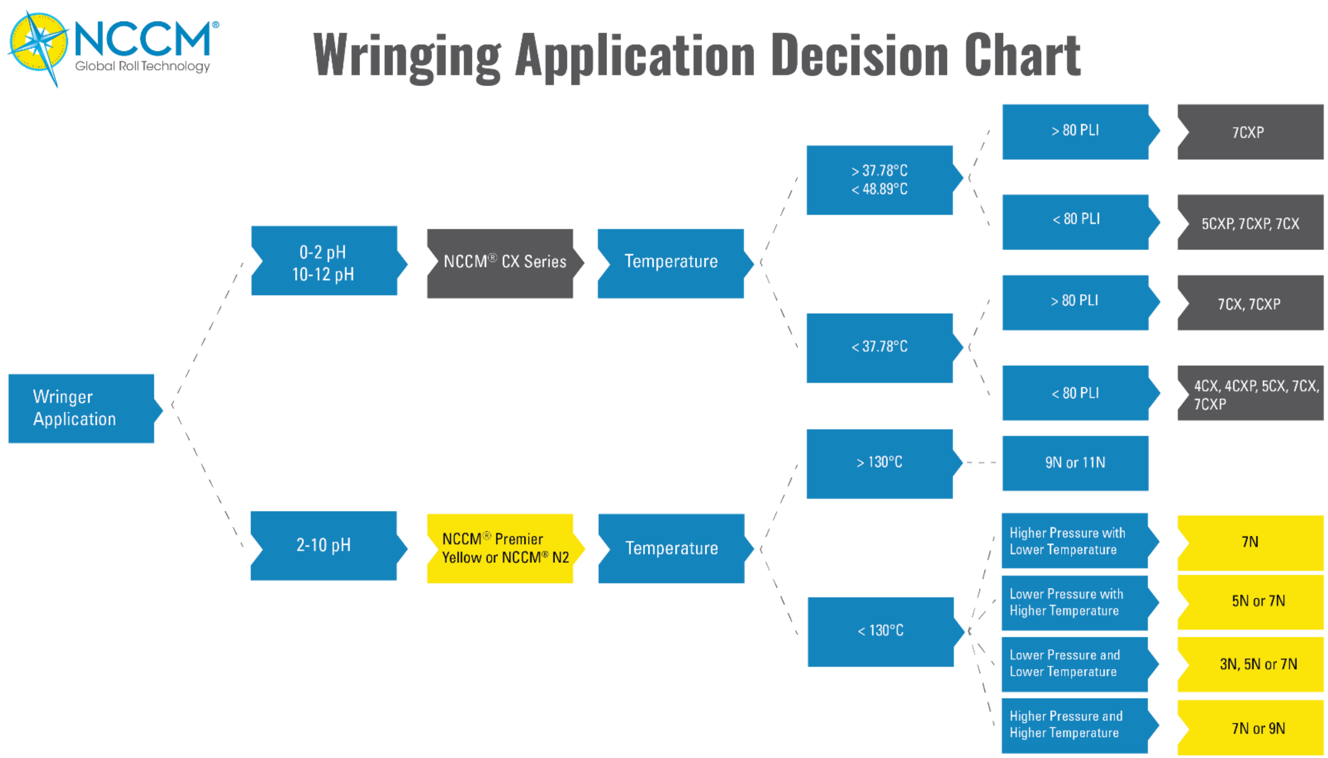
Shaft Deflection and Crowning: It is important to obtain a consistent nip width across the face of the strip, and depending on the shafting and pressure requirements of the roll, it may be necessary to crown the roll. This is done to correct the deflection of the shaft due to high forces on the ends of the shaft and to obtain the same size nip width across the surface of the strip. Higher deflection will require a more aggressive crown. If the size of the shaft is not a set variable, it can be adjusted to minimize deflection. A shaft can also be made solid or hollow to achieve ideal deflection based on machining capabilities.

MRSAT: One of the most useful tools for designing a mill roll is the NCCM® Mill Roll Structural Analysis Tool, or MRSAT. This complex analysis simulation will help design the setup of a roll to ensure the desired parameters are met for the roll being engineered. It simulates shaft deflection to help construct the appropriate parameters and build analysis along with also calculating the final PLI, nip width and many other useful quantitative properties of the final assembly. MRSAT should always be used BEFORE choosing a product type when developing new assembly for installation.

Effective Product Selection: Product selection can be very simple or very complex. It is often useful to have a visual aid to decide the correct product for your wringer application. The organizational diagram below can help by providing a base for understanding the correct product for most wringing applications.

OPERATION

Incorrect operation of any wringer roll can diminish its life. It can also decrease the effectiveness of the roll, the machine efficiency and the quality of the product. Main operational failures include over or under pressuring the roll, line speed adjustments, improper fluid control and fluid contamination and pass-through. Any of these issues can cause a minor failure, and some can cause catastrophic failure. To ensure proper use of the roll, follow operational parameters set when the roll is engineered.



<u>Over or under pressuring:</u> The main idea behind pressure is built into the design of the roll. The goal is to make and obtain a particular nip width. This nip width is generally about 1 inch across the face of the roll and is obtained by applying the pressure determined when the roll was engineered. Deviating from a 1 inch nip width can cause quality issues along with minor and catastrophic failures. With this said, the 1 inch nip is a rule of thumb and is not entirely conclusive. The nip range can be slightly adjusted because

of density and can be fit into a range of nips between 0.8 inch and 1.2 inches. At similar pressures, a more dense roll is naturally going to have a smaller nip than a less dense roll and still perform well. The density of the roll and the pressure required should be included in the design of the product. Other factors that can affect the nip width are roll size and product type. A larger diameter roll will obtain a wider nip at lower pressure than a smaller diameter roll. A softer product like the NCCM® NS will compress more easily than a harder product will at the same lower pressure. If the designated pressure that was set when the roll was engineered is causing operational or performance issues, the problem should be looked at by a plant engineer to find the root cause of the failure. It is often harmful to the product to simply adjust the pressure to get a desired result.

<u>Line speed adjustment:</u> When a roll is engineered, it is done with line speed in mind. Line speed can affect operating temperature, pressure and other parameters that were already taken into account when designing the roll. Machine speed should not be adjusted unless the roll was designed within the parameters of the speed adjustments. The main issue with line speed changes is the performance of the product. Quality issues can arise when the line is running faster or slower than it should. Because NCCM® nonwoven rolls are superior to rubber and other nonwoven rolls, they help maximize line speeds. Lines often run faster with NCCM® rolls than they did when using other products. NCCM® nonwoven rolls provide better friction than rubber, urethane and other non-wovens, which is the reason lines can run faster with NCCM® rolls. This is just another value-adding characteristics provided by NCCM® nonwoven products.

<u>Fluid contamination and pass-through:</u> Product failure often occurs because of chemical attack. When using a NCCM® wringer roll, it is important to use the roll within the designated pH level, or chemical attack can cause roll failure. Experience shows that occasionally, after a chemical rinse, nip rolls aren't being shut fast enough. This can cause acidic or caustic fluids to carry over onto NCCM® Premier Yellow nonwoven rolls. Since these rolls are not designated for these higher or lower pHs, it can cause the roll to breakdown and eventually fail if the carryover occurs consistently. Therefore, it is important to confirm the fluid pH is within the operating parameters of the roll at all times. The easiest way to prevent a chemical attack on the roll is by asserting higher standards on process controls and operator accountability and training.

<u>Improper fluid control:</u> NCCM® mill rolls are the best wringer rolls in the world. They provide the best product quality, possess the longest life and add the most value to any steel processing operation. For NCCM® products to work correctly, it is important to maintain proper fluid control. The biggest performance failure of NCCM® products is incorrect fluid maintenance. Important factors to consider when processing product are as follows: maintaining proper pH, maintaining a consistent temperature and keeping fluid clear of debris by proper filtering. If the pH is not well maintained and spikes above or below the operating limits of the roll, it can cause a chemical attack and failure of the roll. A similar issue can occur with temperature adjustments. When the fluid tank is not filtered properly, it can cause debris build up on the roll. This requires the roll to be dressed because it won't maintain film thickness. In fluid control considerations, there are three important aspects to ponder.

1. *Edge Wetness*: The main factors in the edge wetness on the strip are density of the roll, type of product, thickness of the steel and speed of the line. Density affects hardness, and softer rolls provide better edge wetness than harder rolls. This is due to the need of malleability on the roll to conform around to seal the edge of the strip. If edge wetness is an important factor in the processing line, it should be considered when determining the density of the roll. If the line conditions require a higher density roll but edge wetness is a continuous problem, product type would be the next way to obtain the desired edge conditions. Rolls such as the NCCM® NS can provide the softness to conform to the edges. However, going to a softer roll or product can cause roll failure. This is because softer products are more susceptible to cutting and gouging from a more aggressive strip edge. Thicker steel will cause higher edge wetness for the same reason. The roll just can't conform enough to seal the edge of the strip. Finally, line speed affects the overall wringing of the product. A faster line speed is going to leave a heavier film, and if the edges are already not fully sealing, the problem will escalate on the edges.

2. *Heavy pass through in spots on the strip*: Spots of increased pass through (generally in the center of the strip) are caused by either overpressuring the roll or poor roll design. The root cause of the pass-through is deflection of the roll. Roll deflection will cause a non-uniform pass-through because there isn't equal pressure across the surface of the strip. If the roll is being overpressured,

the ends of the roll will have a higher pressure than the center and will leave the sides much dryer than the middle. The same thing happens due to poor assembly and design. If the roll is improperly crowned or not designed properly, you will again see deflection and therefore inconsistent pressure across the surface of the strip.

3. *Dryness Expectation*: Each wringing system is unique to each customer. Different aspects of wringing differ in importance to different people. Sometimes edge wetness isn't a problem, and the most important thing is getting as much fluid off of the strip as possible. To others, edge wetness is the most crucial part of the wringing performance. Each customer's needs should be considered when designing a wringer roll, and the wringer system should then be developed to meet those needs. This can be tailored to each circumstance by selecting roll type, density, operating parameters and system engineering.

COMMON FAILURES AND POOR DESIGNS

In the field, failure can happen. However, oftentimes failures could have been easily prevented and money saved. When failure does happen, it is important to look at the root cause of the problem instead of making assumptions about product quality issues. Most of the time, a product failure is due to incorrect use or poor design. Some common design flaws causing failures or poor quality include:

1. *Improper Crowning*: When the roll is not properly crowned, the deflection is not equalized across the surface of the roll. As stated earlier, a higher film thickness arises in certain areas and causes failures and lowered performance.

2. *Surface finishing*: The surface finish relates to how well the wringer performs and the "break in" period of the rolls. When improperly finished because of surface melting or too rough a finish, the roll can lose performance in fluid control.

3. *Product Selection*: When the product isn't properly engineered for the application, failures can happen. If the product chosen is used in a higher temperature or in a pH outside the product limit,

failures are much more likely to occur. The application should never exceed the chosen product's maximum operating parameters.

Other causes of common failures include application settings and maintenance neglect. When operating a wringer roll, it is crucial to stay within the operating parameters of the product. As stated before, overpressuring the roll is a common problem. If a roll is not performing properly, oftentimes the instinctual decision is to simply increase the pressure. This can then cause unexpected deflection and therefore minimize performance. Proper fluid maintenance is also a common problem in wringing systems. When not properly maintained, problems commonly seen are pH fluctuations, improper filtration and viscosity consistency. All of these problems can lead to product deficiency or failure.

CONCLUSION

NCCM® nonwoven rolls are the highest performing rolls on the market, and NCCM® wringer rolls are the best in the world. However, it is still important to properly design and operate a wringer roll to maximize both efficiency and life of the product. Longer life and better efficiency lead to better yield and a higher quality product along with lower material and scrap costs. There are many situations that can cause product efficiency problems or outright failures, and it is important to determine the actual cause of the problem. When properly designed and installed, NCCM® mill rolls will increase machine efficiency, decrease quality costs, lower environmental footprint, save on material usages and yeild many other benefits. Keep in mind it isn't just enough to use the best product available; it is just as important to maintain high standards for design and operation.