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Tests for corrugator roll wear

Scope

Singlefacer corrugator rolls are very important components in the corrugating process. They produce the fluted medium which is the foundation on which the quality of corrugated board is based. If the condition of the corrugator rolls is allowed to deteriorate, board quality and corrugator productivity will deteriorate with it.

Corrugator rolls are hollow steel cylinders, with gearlike teeth (or flutes) machined onto the surface. The entire surface is overlaid with a coating – often chrome or tungsten carbide – which protects the underlying steel flutes from wear. During the running life of a corrugator roll, wear caused by friction from the corrugating medium gradually wears away the roll coating, thus exposing the machined steel teeth underneath to wear. If the base metal is allowed to wear without recovering it with a fresh coating, a noticeable drop in flute height (caliper) will occur, and high-lows (a condition whereby flutes are not uniform height exiting the corrugators rolls) will become more pronounced. The corrugator roll will have to be recut, rebuilt to original specifications, or even scrapped.

A simple test, called the copper sulfate test, can be run to determine the condition of corrugator rolls.

NOTE 1: The copper sulfate test works well to expose the wear patterns on chrome-plated corrugator rolls. A commercial product called Insta-Blak can only be used on tungsten carbide-coated rolls, as well as rolls with a stainless steel substrate. It is more effective on such substrates and can be used similarly to the copper sulfate solution. It will turn exposed steel/stainless steel black in color.

Safety precautions

For best results, corrugator rolls should be cold. If applied to hot rolls, the solution will boil and may splatter onto the skin.

These solutions may be slightly acidic. Use PPE per the SDS. It is best to rinse off the application area and clean the area with alcohol when finished.

Materials

- Cupric sulfate pentahydrate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) or equivalent (such as Insta-Blak)
- Beaker or cup of at least 100 mL capacity
- Water (tap is okay)

Procedure

To prepare the test solution, mix cupric sulfate pentahydrate Powder ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) or equivalent (see Note 2) in water. About 5-10 gms cupric sulfate per 100 mL water is sufficient; about 200 mL of solution is adequate to test a corrugator roll.

NOTE 2: Copper sulfate comes in many forms. It is always recommended to purchase a powder rather than the flake or rock variety, as the powder will go into solution very readily. "Cupric" sulfate and "copper" sulfate are essentially the same chemical, different terminology.

When the rolls are cold, clean the surface to be tested. Use of an electrical contact cleaner to remove any organic materials is suggested. Pour or spray a small amount of the copper sulfate solution across the width of the corrugator roll. Make sure at least five or six flutes are coated with the solution. If the flutes' coating is intact, the area that the copper sulfate contacts will turn a silvery blue color. Wherever the coating has been worn away, the contacted area will appear brown to rust in color. Rotate the roll and repeat the test, observing for wear in each location. A minimum of three tests around the circumference of the roll should be done. Once the test has been completed, clean the test sites thoroughly and coat with oil to prevent medium wrap-up upon startup.

NOTE 3: Be aware that chrome and tungsten carbide, even as dense as they are, still are somewhat porous. The solution may work its way through small cracks and pores in the coating, producing brown speckled appearance.

Recommendations

If there is a loss of coating on the tips of the flutes, or if coating loss is 1/3 or more up the flank of the flutes, the corrugators rolls should be considered for removal. By pulling them out before wear is severe, recuts can be avoided and the rolls can be recoated before damage is done to the steel. This practice should extend the life of the corrugator rolls from three to five times (have rolls inspected for embrittlement of the steel after the third time) barring damage from some other source.

It is recommended that the copper sulfate and Insta-Blak tests be conducted on new/recoated corrugator rolls prior to installation, one week after installation, then approximately once every quarter thereafter.

NOTE 4: The coating on corrugator rolls can wear unevenly, leading to variations in flute heights. These variations may require replacement of the rolls long before the test above will show wear through to the steel substrate, particularly on tungsten carbide-coated rolls.

Flute tips: Chrome and carbide thickness (or coating thickness) gauges are available from a few different companies. The most common and least expensive is a pen sized gauge which has a small spring-loaded magnetic probe (see Figs. 1 and 2). It's best to inspect the corrugating rolls when they are cold. A more thorough inspection can be done when the rolls are out of the machine. The tip of the gauge with the magnetic probe is placed on the flute tip so that the probe touches the chrome. The gauge is gently pulled away perpendicular to the surface until the probe releases. The chrome thickness must be read on the scale quickly at the point the spring-loaded probe releases and retracts back into the gauge. Several readings should be taken and the lowest one should be recorded. It may take a little practice to master this gauge and get accurate readings.

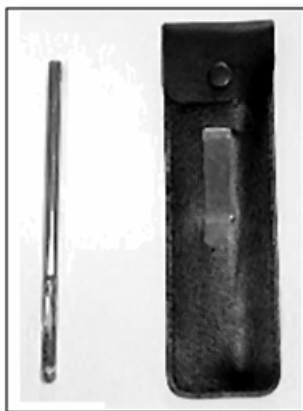


Fig. 1. Gauge with spring-loaded magnetic probe

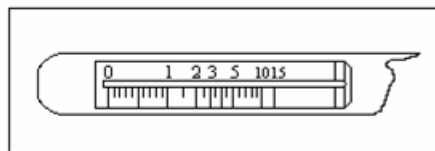


Fig. 2. Gauge scale for coating thickness readings