Ward Flexo 329 Scrap Evacuation

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Problem Statement

Figure 1: *Scrap buildup in the rear of the Ward Flexo 329*

Scraps produced in the die-cutting process of corrugated containers at PCA build up in the rear of the Ward Flexo 329 (Figure 1). The machine must be shut down to clear the scraps, reducing factory production. A solution to effectively remove scraps and integrate with existing machinery must be designed. The solution will remove scraps adhered to the die-cut anvil and direct all scraps to the existing evacuation system. The solution will eliminate downtime of the Ward Flexo 329.

Abstract

PCA is one of the United States' largest producer of corrugated packaging and container boards. Manufacture of container boards requires die-cut machines that create perforated cuts for custom designs. The Ward Flexo 329 contains a die-cutter to create each unique cutout. Many of the scraps produced during the die-cutting process remain adhered to the anvil's surface and are deposited in the rear of the machine. Scraps buildup over time (Figure 1) forcing shutdown of the machine line for manual clearing two or three times each shift. Manual clearing requires thirty minutes to an hour, reducing Ward Flexo 329's production by 9,600 to 30,000 boxes per shift. A custom nylon-bristled roller fit over a hollow aluminum shaft was designed to direct scraps coming off the machine forward onto the existing conveyor belt evacuation system as well as remove scraps adhered to the anvil (Figure 2).

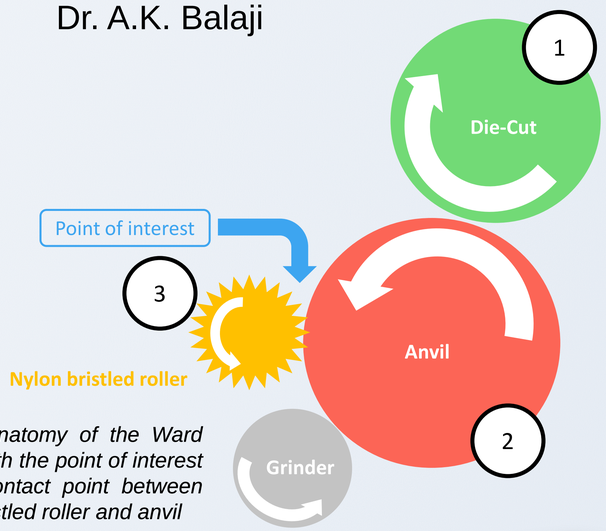

Figure 2: *Anatomy of the Ward Flexo 329 with the point of interest being the contact point between the nylon bristled roller and anvil*

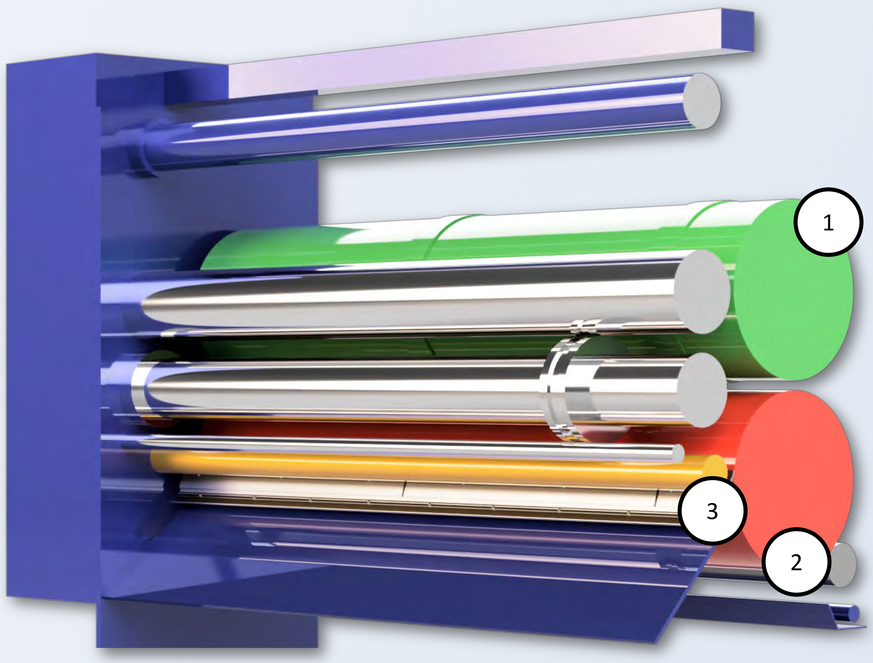

Figure 3: *Isometric cut-away view of the Ward Flexo 329*

Method

Rotation of the bristled roller with the anvil will direct scraps forward onto the existing evacuation system. Given the space limitations within the machinery, a gear train tying into the existing chained drive will drive the bristled roller (Figure 3, Figure 4). A gear ratio of 1:3.2 will be employed to evacuate all scraps assuming maximum scrap production per corrugated sheet.

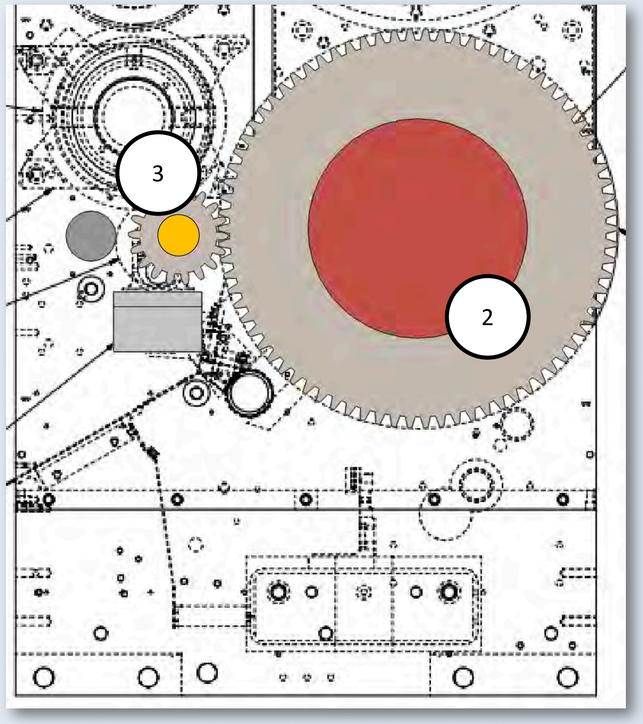

Figure 4: *Side view of the Ward Flexo 329 overlaid technical drawings of the Ward Flexo 329's interior. A gear ratio of 1:3.2 is employed to achieve a bristled roller speed of 16 rad/s from the anvil rotation of 5 rad/s*

Finite Element Analysis (FEA)

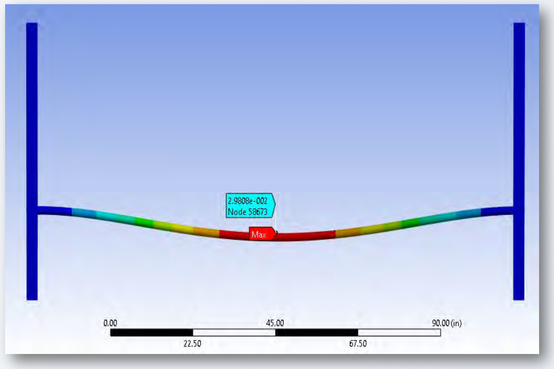

Figure 5: *Maximum rod displacement of 0.0298" occurs at the center of the rod*

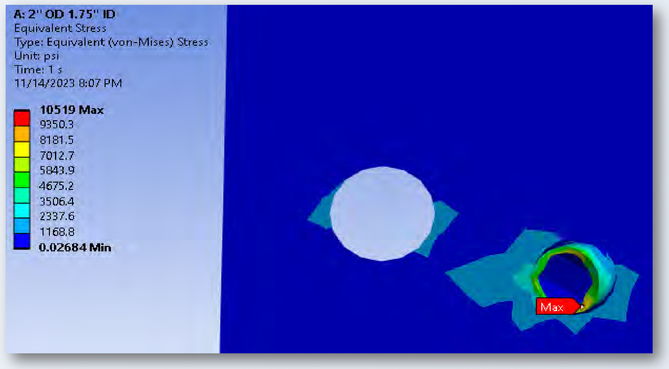

Figure 6: *Maximum stress of 10519 psi occurs between the rod and side wall*

0.0298" is the maximum deflection of the aluminum shaft (2" OD, 1.75" ID) which occurs at the center of the rod (Figure 5). A maximum stress of 10519 psi is located at the interaction between the side wall and roller (Figure 6). The same location experiences the minimum factor of safety of 1.14. The FEA results confirm that the bristled roller meets operational requirements.

Conclusion

Proof of design concept involved installation of a static, linear brush on the Ward Flexo 329. The preliminary linear brush test proves the ability of nylon bristles to remove scraps adhered to the anvil and evacuate all scraps produced. Designs for the nylon bristled roller, manufacturer contacts, and installation procedures have been provided to PCA who will oversee the modification to their machinery.

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