

## Background and Product Overview

Tuthill has over 75 years of experience manufacturing a wide range of positive displacement pumps that address many of the challenging applications in the paper industry. Tuthill offers positive displacement pumps in the circumferential piston, internal gear and external gear designs, ranging in capacity from .5 GPH to 550 GPM and available in iron, stainless steel, and other materials. Tuthill Pump products have established a reputation for reliability and durability in the equipment machinery and process industries.

The Tuthill HD Series is a circumferential piston pump capable of running dry without damage, handling a wide range of viscosities and slurries, and is a low-shear design. The design incorporates the use of externally-mounted, synchronized timing gears operating close clearance impellers with external shaft-bearing support. It is available in ductile iron and stainless steel construction as standard. Because of its non-clogging design, handling wastewater sludge is a common HD application.

GlobalGear® is a heavy-duty internal gear pump that features an external thrust bearing and heavy-duty bracket for supporting bearings and mechanical seals.

The GlobalGear® internal gear design pump offers more robust construction and a modular design capable of back pullout access to the fluid chamber without disturbing the pipe. The modularity features also minimize maintenance costs and inventory requirements compared to other internal gear pumps. GlobalGear pumps are available in cast iron, stainless steel, and other materials upon request.

Lower flows are addressed with the L & C series of products that include a wide range of integral close-coupled pumps and motors, and CC Series of flanged-mounted pumps for use with NEMA C faced motors. These pumps are used for lubrication services on many different types of rotating equipment and processing machinery.

The Tuthill Technaflo Products include precise, low-flow pumps. They are available in a variety of pump head materials of construction and are capable of adjustable flow rate with variable-frequency drives. The pumps can be combined with accessories and fabricated systems to meet a variety of chemical and process-feed requirements, such as pumping inks and wastewater treatment chemicals.

Tuthill is a leading manufacturer of positive displacement pumps that serve a variety of applications in corrugated box converting plants.

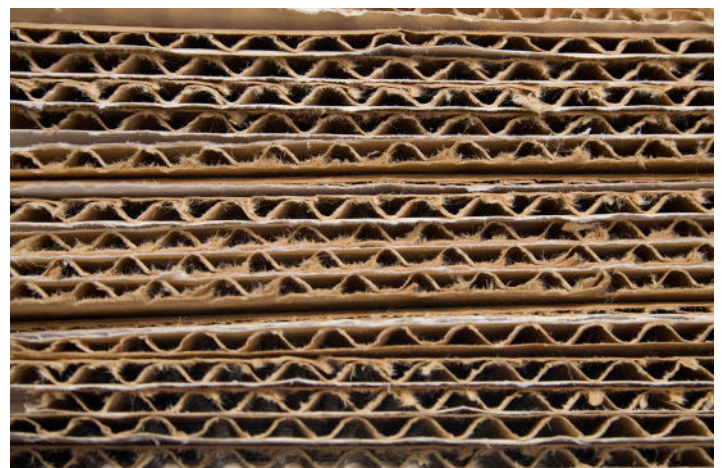
For low flow, precise pump applications such as inks and wastewater treatment chemicals, Tuthill TechnaFlo products are available in a variety of materials of construction. These pumps can be supplied with variable speed drives and accessories to support a variety of chemical feed and dispensing control systems.

## Corrugated Box Applications Overview

A very common application for internal gear pumps is starch handling at corrugated box plants. There are hundreds of corrugated box plants located across the country. The larger integrated paper companies such as International Paper, Smurfit-Stone, Weyerhaeuser, and Georgia Pacific own some of these plants. Others are regional and local independent box plants.

## Starch Pump Application

Corrugated sheet is made by gluing a wavy sheet, or flute to the outer and inner flat sheets or liner boards. Figure 1 shows a diagram of corrugated box construction. The glue is a starch-based adhesive that is commonly referred to as starch or gum. The flute is glued to the liner board pieces in a machine called a corrugator. Figure 2 shows a corrugator machine. Internal gear pumps are frequently used to pump the starch from a storage tank to a tray in the corrugator. Internal gear pumps are chosen for their ability to deliver constant pulse-free flow along with energy-efficient pumping for this continuous duty application.



**Figure 1: Corrugated box construction**

There are typically several internal gear pumps in a corrugated

box plant, and depending on size of the plant, and the number of corrugator machines, there may be up to a dozen internal gear pumps. Figure 3 shows the whole process of gluing the flute to the liner boards within the corrugator machine.

The internal pump brand most frequently used for this application is Viking. Construction is cast iron; pump size is typically a 2" KK or L model size; pumps are supplied either as packed with bronze bushings, or with a behind-the-rotor mechanical seal and carbon bushings. Extra clearances are generally not utilized. These pumps are often belt driven with pump operating speeds in the range of 400 to 600 RPM.

Starch-handling internal gear pumps are most often not supplied with safety-relief valves. Line blockage because of the starch settling out in the discharge piping is a fairly common occurrence, and pump and mechanical seal damage can happen in the event of line blockages with no pump relief valve for overpressure protection. On the other hand, in the event of pressure spikes, the relief valve can open and not reseal, resulting in relief valve chattering, bypassing of fluid, and loss of flow.



**Figure 2: Corrugator Machine**

Problems encountered with internal gear pumps on this application include:

- Excessive leakage from packing where packing is used
- Short mechanical seal life where mechanical seals are used
- Viscosity thinning of the starch due to excessive recirculation in a worn pump, or a pump where clearances have opened up

GlobalGear® is a proven performing in starch adhesive services, and GlobalGear can be applied to address all three of these concerns. First, the recommended seal arrangement is a behind-the-rotor seal with carbon on ceramic faces. Either a Buna or Viton seal may be applied. A bronze bracket bushing and a carbon idler bushing should be selected.

Several design features serve to improve mechanical seal and pump life. The GlobalGear® design includes, as standard, a vent to suction in the seal cavity area that serves to reduce pressure in the seal area and prevent starch from becoming trapped in the area behind the rotor. If starch becomes trapped in this area, it will gelatinize, solidify, and open up the seal faces. The Viking pumps used in this service do not have as a standard feature anything to prevent trapping starch behind the rotor. The vent to suction also acts as a shock absorber that will dampen the pressure spikes that the mechanical seal would see in the event of a line blockage.

As for withstanding the effects of pressure spikes due to line blockages, GlobalGear® uses a 1.75-inch diameter shaft where the competition uses a 1.44-inch diameter shaft. The oversized shaft serves to reduce shaft deflection by over half, which serves to extend seal life significantly. Shaft deflection caused by pressure spikes will cause the seal faces to open up, and may result in premature leakage and seal failure.

Additionally, the oversized shaft and bearing will better withstand the effects of belt-drive side loads and vibration.

GlobalGear® is constructed to last longer than the major competition. Less shaft deflection reduces the contacting and rubbing of the gear surfaces. Also, GlobalGear® has ductile iron rotors and idlers compared to the cast iron used as standard by the competition. The ductile iron is significantly harder than the common grades of cast iron used, providing better wear characteristics.

GlobalGear® uses a heavy-duty jack screw arrangement to set and maintain end clearances. The GlobalGear® jack screw arrangement is similar to what is used successfully on heavy-duty process pumps. The competition uses a single setscrew on a threaded bearing end cap to maintain end clearance. With a belt drive especially, there is plenty of vibration present. The vibration can cause the setscrew to lose tension which would allow the shaft to move, opening up pump end clearances. Opening up end clearances will cause significant internal recirculation within the pump, which may result in undesirable thinning of the starch viscosity.

Recent practice has been to use an internal gear pump in the storage-to-starch tray in the corrugator application, and to use an air-operated diaphragm pump for the return from the starch tray to the storage tank application. Because of the packing leakage, seal unreliability, and viscosity thinning issues, a number of plants have converted the supply pumps from the internal gear design to the air-operated diaphragm type.

It should be considered that the air-operated diaphragm pumps in this service consume several times the amount of energy compared to an internal gear pump. The incremental energy costs may amount to several thousand dollars per pump annually. Also, air-operated diaphragm pumps tend to be maintenance intensive for

continuous duty process operations. While air-operated diaphragm pumps are not damaged by line blockages, the pulsating flow can provide greater opportunities for line blockages to occur, and the air-operated diaphragm pumps are very limited in their ability to generate sufficient pressure to overcome blockages.

Tuthill GlobalGear® now provides corrugated box converters with a new and better option for reliable, leak free, and energy efficient starch pumping. Some manufacturers call their pumps heavy duty. GlobalGear is built heavy duty, and it does not take more than a side-by-side look at a GlobalGear® Model next to a comparable Viking model to tell the difference.

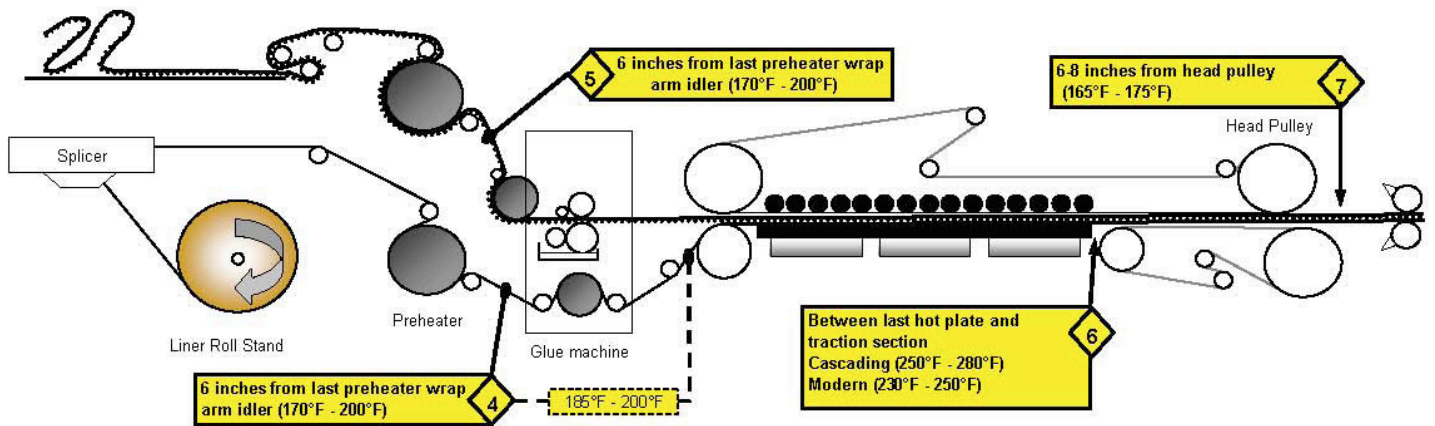


Figure 3: Process of gluing flute to liner boards within the corrugator machine (Smurfitt-Stone)