



Needed Math Project

Award # ????????

Developed by Professor Jay Martin, Wake Technical Community College

Company and Contact inspiring Topic:

Morris and Associates

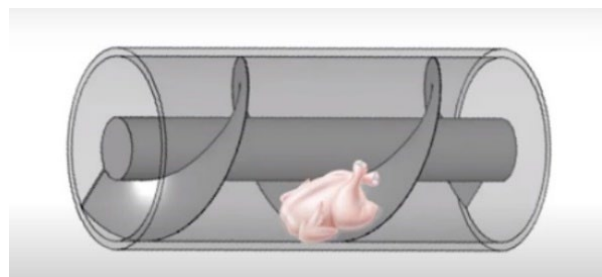
Garner, North Carolina

Michael Gibson – Community College graduate and now General Manager

Morris and Associates is an Engineering Company located in Garner, NC. Their primary business is to build machines that cool with water. For example, they make machines that produce ice. They also build machines that cool chickens. They are a full-service company that designs, manufactures, installs, and services their products.

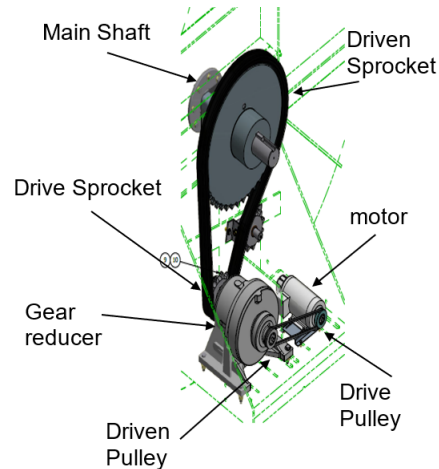
Brief Description:

In the poultry industry, cleaned chickens are cooled down to make ready for packaging. The designing and manufacturing of the cooling system requires a pulley system that can be driven by a small motor to rotate a large auger that moves chickens through a cooling system very slowly to bring the temperature down to ready the chickens for packaging. The use of small motors and gear reductions helps with the longevity of the machine and motor, which brings down the cost of maintaining the cooler.



Issue Addressed:

The chicken coolers can range from 25 feet long to 108 feet long and the large auger is driven by motors that range from 0.5 hp to 3 hp. The chickens will take over an hour moving through this system to reach the correct temperature needed for packaging. This specific cooler is using a small motor that runs at 1725 rpm to drive the large auger needing to rotate at 1/3 rpm in order for the chickens to move through the cooler in the right amount of time. A gear reducer of 1505:1 is also being used to help reduce the rotation speed. The dimension of the large driven sprocket needs to be sized.



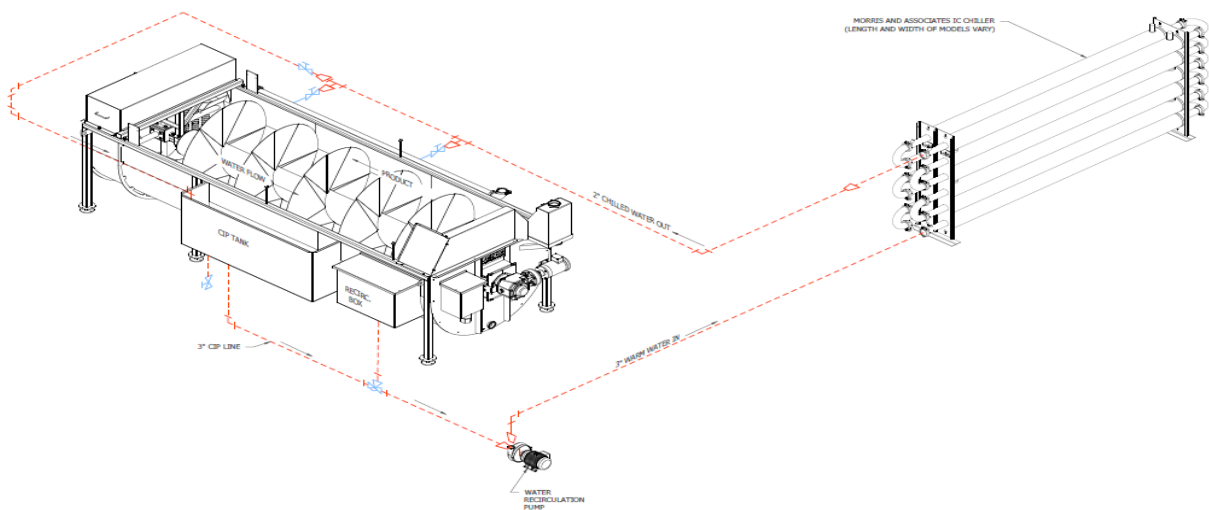
Math Topics Applied:

Direct and Inverse Proportions

Questions to Address:

1. What Driven Sprocket diameter would produce 1/3 rpm of the main shaft of the auger given the below specs?
 - Drive Sprocket Diameter 6.8 inches
 - Drive Pulley Diameter 3.4 inches
 - Driven Pulley Diameter 4.2 inches
 - Gear reducer 1505:1
 - Motor produces 1725 rpm's of the drive pulley

2. During the day, water runs through the product chiller, the pipes, and the heat exchanger to help cool the chickens. At night hot, soapy water runs through the tubing, CIP tank, and heat exchanger in a loop to clean the tubing. This is why we call this a Clean in Place tank. The image below shows both the machine that cools the chickens and the pipes used for the heat exchange. The pipe distance to the CIP tank is 100' and the pipe distance away from the CIP tank is 100'. All pipes have a 3" diameter. There are 11 elbows on the heat exchange unit. Each of these elbows has a length of 12". Each tube in the heat exchange is 10' long and there are 12 of them. You have to determine what size CIP tank to use so that there is always water running through the pipes with some in the tank.



The CIP tank must be filled with enough hot soapy water to clean the entire run of tubing. Industry standard is to size the CIP tank at least 15% more than the volume of the tubing so that there will be some water left in the tank after the tubes are filled. What size CIP tank should you put on the machine? If the height of the tank is 3', recommend CIP tanks with 2 different sets of dimensions.

Teacher Resources:

Video that introduces Morris and Associates, Michael Gibson's success story, and a contextual introduction to the design problem:

<https://youtu.be/wOrHmP3H4m4>

Teacher Desmos activity that contains pre-requisite math skills:

<https://teacher.desmos.com/activitybuilder/custom/601a888bbf3c530d1e29dc8d?collections=5f6cae0049988f0bfcd6f9f8>