TINCAN: DECISION SUPPORT TOOL FOR GRAIN CROP STORAGE AND CONDITIONING ACTIVITIES.

Student: *Edgar Francisco Soler.* **Sponsor:** *MITACS accelerate program - Weather innovations .* **Supervisor:** *Vladimir Mahalec*

McMaster University ENGINEERING

Project Goal:

Create an automated "on line" decision tree for crop conditioning that allows predict and control the behaviour of key indicators during the grain storage.

Requirements:

- *Identify the main factors that are related to the storage of grain as well as the relations between those factors.*
- *This on-line tool is designed for farmers . It allows to farmers having forecasted information of the conditions of the grain inside the bin – moisture content, air temperature - that are useful to make right decisions about the drying and storage of their crops.*

Engineering Basis:

- *For grain and seed crops low temperature grain dryers –air temperature, ambient to ambient plus 5 C- have been considered to be a low capital cost, energy efficient alternative to high temperature dryers . In this project , the core of the research is near ambient drying (see Figure 1).*

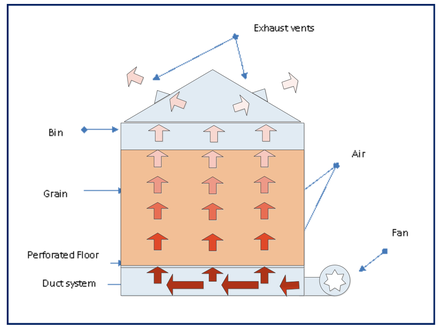
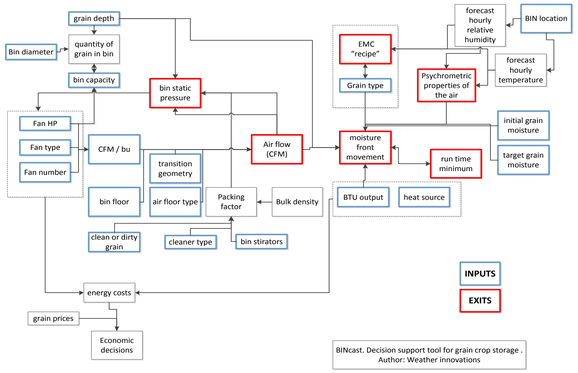


Figure 1. Common set up for aeration and near ambient grain drying.

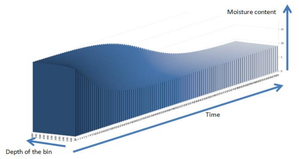
Analysis of Factors

- *There are three kinds of factors to consider into the design of TINCAN. In first place, factors related to the environment conditions. Second, factors related to infrastructures and installations and third is related to the kind and specific conditions of the grain. These factors and relationships are:*

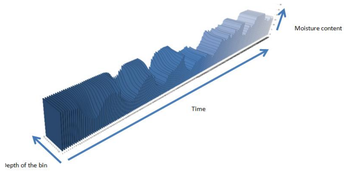


- *The model used is based in the assumption that the sensible heat lost by the air flowing through the bed is equivalent to the latent heat due to moisture vaporization. Therefore the energy balances inside a control volume isolated from the bed are reduced to:*

$$G_a C_{pda} \frac{\partial T_a(x,t)}{\partial x} = h_{fg} \rho_p \frac{\partial H_p(x,t)}{\partial t}$$



Moisture content behaviour in relation to time and depth (constant cond.)

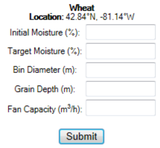


Moisture content behaviour in relation to time and depth (variable inlet air temperature and humidity).

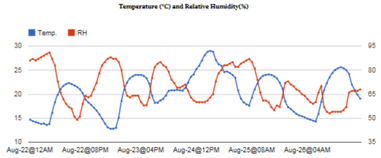
Results

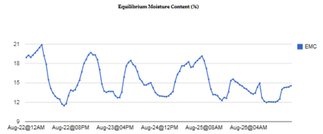
Three versions of TINCAN were developed: Last version includes calculation of Equilibrium Moisture Content, and simulation of moisture content and temperature inside of the bin.

1. The user inserts information related to his crop and bin (location, height, fan, etc)

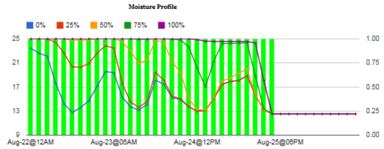


2. Information related to the forecast for the next 5 days and EMC are obtained.





3. A profile of the moisture into the bin and a schedule for turning on-off the fans is obtained.



The lines represent the moisture content at different levels into the bin (0% is the bottom and 100% is the top)