Controlling Condensation in Potato Stores

Introduction

Condensation occurs when humid air comes into contact with a surface (or another air stream) which is at a temperature below the humid air's dew point. At this temperature, the air is 'saturated' with water vapour and can hold no more. If its temperature continues to fall some of the vapour contained in the air will change to water and condensation will occur. Condensation occurs mostly on solid surfaces, but where the cooling of the humid air is caused by a cold air stream this leads to the formation of a 'fog'.

Why is condensation often a problem?

One of the main characteristics of a successful potato store environment is the presence of cool humid air, which preserves the crop for long periods and minimises weight loss through dehydration. Since this air is very humid (usually above 95%) it only has to cool very slightly to reach its dew point - so the slightest drop in temperature will lead to condensation which causes a number of adverse effects in the store:

- Break down and damage to building components, especially woodwork and insulation.
- Damage to the crop through rotting and the promotion of skin disease.

Where and why does condensation occur?

Condensation can occur anywhere in a store where air is cooled through contact with a cold surface. Condensation can occur on building components and on the crop. The most common areas for building condensation are as follows:

- *On the underside of the store roof*
  This is caused by humid air rising from the crop into the roof space and onto the roof structure which, because of cold outside conditions, has become chilled. This occurs most commonly on steel roof members which conduct heat well and therefore become chilled quickest. This phenomenon is known as 'cold bridging', as the steel forms a cold bridge between the outside and inside of the store. Similar conditions can also occur on walls. Crop damage can occur when the condensation drips down onto the surface of the crop.
- *Around doors and air inlets/outlets*
  This is usually due to slight air leakage around the opening which leads to cold outside air chilling the edge of the door/louvre material. Again the slightly warmer store air touches this cold surface and condensation occurs.

Farm Energy Centre, NAC, Stoneleigh Park, Kenilworth, Warwickshire CV8 2LS
Telephone: 024 7669 6512 Fax: 024 7669 6360 Email: info@farmenergy.com Web: www.farmenergy.com

- *Within insulated roofs and walls*
  This is called interstitial condensation and occurs when air in the building leaks through gaps behind and into insulation. This air becomes chilled through contact with the material beyond the insulation and deposits condensation within the building fabric.

Crop condensation occurs in three main ways:

1 The respiration of the crop leads to a slight increase in air temperature and this air rises through the crop layers because of its increased buoyancy. As this air gets near to the top of the crop heap it may come into contact with cooler potatoes which have been chilled by the cooling air and condensation occurs.

2 Following opening or ventilation of the store, when the outside air is humid and slightly warmer than the stored crop, the outside air will deposit its moisture on the potatoes.

3 Following opening of the store doors or ventilation of the crop in cold conditions, the potatoes closest to the incoming cold air become chilled. On closing the doors or cessation of cooling, the cold potatoes will again chill the generally warmer store air, and condensation will occur.

What are the best ways of avoiding condensation in stores?

Fundamentally there is one golden rule which, if followed, will always avoid condensation. That is: eliminate all temperature differences between the air and all surfaces in the store. If there are no 'temperature gradients' there can be no condensation.

Here are some of the practical answers to condensation control:

- Insulation - Insulation stops 'cold conduction' from the outside and is essential for all building structural components. This is especially important for steel structural supports that conduct heat easily. Use insulation which is naturally waterproof, or incorporates a 'vapour barrier' to stop moisture migration.
- Recirculate air in the store, and through the crop. Air movement helps eliminate temperature gradients in the building and in the stack and is key to stopping condensation on the tubers themselves.
- Seal doors and louvres well. This will help reduce both the chance of condensation around these components and crop condensation from the effect of air ingress
- Keep doors shut. This will stop outside air chilling the crop or directly causing condensation on the crop. Use small access doors rather than the main loading doors, and use strip curtains to reduce air movement. Initial store design should incorporate small access doors for inspection, and restrict loading access to sheltered grading areas rather than directly from the outside.
- Warm the crop slowly before removing from the store. This will help prevent crop condensation and damage during unloading.
- Use fans to promote air circulation in the roof area of a store. Sometimes the addition of a little heat can also help. Specially designed crop-head air recirculation systems are available which use either an oscillating, or static fan with perforated polythene distribution ducts. By moving the air, moisture on the building components can be evaporated, and the temperatures within the area can be evened out. The heat is useful for very cold conditions and counteracts the chilling effect of the large roof area which maybe subject to very cold outside conditions. Heaters should be sized at 15W/m^2 of roof area. Fans should be sized at 60m^3/h per m^2 of roof area.
- Use positive ventilation for boxed stores. Letter-box ducting which match the voids in the box stack can be used. Other preparatory systems are available which use plastic ducting attached to the sides of the boxes.

Farm Energy Centre
January 1999

p:/newtnotes/tn69.pm65/10.01