**AKT-KIX**

**Gelatinisation – the cost free way**

In the manufacturing of processed foods for human or animal consumption the process of gelatinisation of starches is used to make foods containing starches more readily edible.

The process is a phenomenon where the starch granules absorb water, then swell and eventually burst out to form a gel in the presence of water and heat.

The gelatinisation process uses starch as a ‘solute’ and water as a solvent.

Gelatinization of starches can be achieved through a range of techniques and with different outcomes. In animal feeds a level of 50% can be achieved in the steam preheating stage during pelletising and extrusion.

The most readily recognised process, which gives a result of some 50% gelatinization is in the production of corn flakes, rolled oats and wheat grains. This consists of the flattening of a grain to make the endosperm accessible to steam introduced by a secondary roller steam applicator or to steam injected by jets after the flattening process.

The main difficulty with this process is that the steam is created by a boiler or multiple boilers, then transferred by pipes to the applicator. Both the manufacture of steam and its transmission through steam pipes forms mineralization deposits that require constant cleaning.

In industry the process of controlling this issue is referred to as blow downs. These are high pressure pulses of steam that clean the pipes. However, because that steam cannot go into the finished product, it is lost and represents an energy loss of some 5% in the overall process.

One way of overcoming or reducing this problem is by using very expensive water softener chemicals to reduce mineralization in the pipes. However, as this steam is to be used on a product for human consumption, even though the water may be potable, the chemicals and their use remains a problem.

What the AKT-KIX process is doing is rather different.

The first thing is that we are not flattening the grain but only cracking it. We do this with a mechanical process which has a total cost of $5000 to achieve a 5 tonne an hour throughput.

Then rather than a momentary application of the water as steam we have designed a process where we immerse the cracked grain in either fresh or salt water until the endosperm is damp.

The water or moisture component of this process can also come in part from the other materials in the mix being dehydrated. It can be from vegetables, fruit waste, dairy effluent, beer manufacturing spent grains, waste food or manufacturing liquids which all can be applied directly to the cracked grain's endosperm, ensuring that you have 40% moisture in the blend.

The grain is held in direct contact with this moisture for 30 minutes so that the liquid comes into contact with the cellular structure of the of the cracked grain. This develops a potential microscopic boiler in every single cracked grain used in the process, each exploding once the heat is applied.

This means we have thousands of instant microscopic gelatinizing boilers at work in the process. In the 5 seconds of the process, we can achieve a required meal temperature of 65 to 75 degrees C.

With this process superior levels of gelatinization of up to 95% can be attained at a fraction more than the cost of extrusion or steam rolling which can only achieve 50%. Better still in the overall process, if you need drying of the wet stream in any case, when this cost is accounted for, the actual cost of gelatinizing the grain is zero. This means the grain enters the process with10% moisture and departs exactly same way, except gelatinized - free of charge!

**But wait there is more:**

In the first part gelatinization is the rupturing of the bonds in the starch molecules. It is driven in part by the application of a water/temperature regime with a given time frame. The meal temperature is grain type dependant and ranges from 55 degrees to 85 degrees. Research now also suggests that there is also a time imperative with the after-process cooling just as there is in the drying itself.

Both parts of the process, heating and cooling have effects. The faster you dry at any set temperature the less damage you exert on the product and with gelatinization the faster you cool the less impact you will have on the gelatinization.

This means that even if the meal temperature reaches the set grain temperature for optimum gelatinization, if the temperature is not held for the correct period of time, it will negatively impact the efficacy of gelatinization. In a review completed by Dr. Sara Beavis on AKT’s own research, when working on gelatinizing sorghum, 50% of the gelatinization of the starch was lost when immediately after the heat phase, a meal cooler element was introduced, this reduced the meal temperature by 40 degrees in 2 seconds.

However, there is much more to be considered when looking at the KIX fluidized bed dehydrator process and its 5 second drying time. Initially swelling of the product takes place and with that:

* Density decreases
* Fat encapsulation occurs to a degree
* Porosity increases
* Water and oil absorption rates will increase

In more recent research we have found that:

Separation of stalk, pericarp and germ will not only happen to a greater extent in a fluidized bed system, but screening of the gelatinized meal from all the rest of the grain parts will have a much higher level of efficiency.

That is greater yield of the meal and much less meal left in the stalk, fibre, germ or pericarp. This is due to the highly explosive nature of the millions of microscopic boilers, mentioned earlier, in the endosperm of the cracked grains.

The greater yield also occurs because of the negligible product compression exerted by a fluidised bed as compared to the compression and agglomeration characteristics of machinery such extruders, pelletisers, presses, roller mills and even to an extent drum driers, with the effects of peening action.

We suggest that after swelling caused by the gelatinization, care needs to be taken that the particles separated are not then reunited with the gelatinized meal by a simple act of compression.

So we should now consider the capacity to develop purer gelatinised meals, a concentrate of sorts, with superior yields and secondary streams with minimal content of nutrient rich materials.

Microscopy shows just how much is lost in those secondary streams and the peening action on meals. I refer here to work completed 25 years ago with Kansas State University on fish meals in a drum dryer.

Reference AKT Report **No.2607**