Microwave moisture levelling of Lucerne Chaff

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To develop of a low cost method of microwave drying of lucerne chaff prior to packaging and distribution. Lucerne has long been used as a high protein food source for livestock in particular for horses fed in the form of a dry chaff.
Lucerne, also called Alfalfa (Medicago sativa) is a perennial flowering plant in the legume family. It is cultivated as an important forage crop in many countries around the world. It is used for grazing, hay, and silage, as well as a green manure and cover crop.
Lucerne hay quality determined heavily by weather conditions.

(colour and Leaf loss)
Lucerne Chaff
Why microwave heating?

- Volumetric heating (removal of bound water)
- Fast
- Low ignition source in dusty environment
- cheap
The designed system consists of seven individual magnetrons providing 1.2kW each of heating power to the chaff on a conveyor belt moving at 0.5m/s. Individual cavities were designed so as to allow the conveyor to move product through the system whilst avoiding adverse interactions occurring between the individual magnetrons.
Power supply

Simple circuit providing 4000V dc applied to the magnetron
Magnetrons

Structure of Magnetrons

- **ANTENNA**
  - RF output

- **MOUNTING PLATE**
  - Setting magnetron to oven

- **YOKE**
  - Magnetic circuit

- **MAGNET**
  - Generator of magnetic field

- **STEM**
  - Input insulation and supporting filament

- **FILTER BOX**
  - Shield of microwave leakage from stem

- **GASKET**
  - Contact to wave-guide coupler of MW oven

- **FILAMENT**
  - Source of thermal electron emission

- **RADIATOR**
  - Heat sink

- **ANODE**
  - Resonant cavity

- **TERMINAL**
  - Input of anode and filament voltage

- **FILTER**
  - Line conductive noise suppressor
Microwave Lucerne dryer cavity (all dimensions in mm)

- Opening for magnetron launcher
- Bolt holes on 25mm flange every 50mm to ensure tight coupling
- Bolt holes on 25mm flange every 100mm to ensure tight coupling
- Fan mounting area - to suit fan
- Grid of 2.5mm holes to allow air flow
- 500 adjust to fit available conveyor width
Prototype System
Performance so far

The system has been constructed and trialled at Putaruru Lucerne and has clearly demonstrated the concept. On one trial the lucerne chaff moisture content was reduced from an unstable 14% down to 9% which substantially extends the shelf life of the end product. This system also means that the lucerne can be baled days earlier at a much higher moisture content removing the current issues around weather stability.
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