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# POSSIBILITIES FOR USING THERMOGRAPHY IN IMPROVING SAFETY IN THE NPK FERTILIZER INDUSTRY

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## I. INTRODUCTION

During the long history of manufacture and use of fertilizers many accidents and incidents has unfortunately happened. Some of them have been smaller and some really severe ones. New ways has been for a long time searched to improve preventive actions to prevent decompositions and in worst case detonations. In some areas thermographic cameras has been taken into use in the field of preventive maintenance to detect risks long before they start to be severe. In addition to preventive maintenance there is big potential for the utilization of thermographic cameras in many other areas. Some of these areas are for example searching and rescue of people and extinguishing decomposition inside NOx gases.

## 2. INFORMATION ABOUT THERMOGRAPHY

Thermography is the use of an infrared imaging and measurement camera to "see" and "measure " thermal energy emitted from an object.

Thermal energy or in other name infrared energy is light that has got so long wavelength that it cannot be seen with human eyes. This part of electromagnetic spectrum we perceive as heat. All particles which has a temperature above absolute zero emits heat and therefore they can be seen with IR camera. With IR camera we can see much more than with our own eyes.

"Nearly everything gets hot before it fails" is a golden rule that helps us to understand why the use of IR cameras has been increasing rapidly. As an example finding and fixing of poor electrical connection before it fails and causes production downtime, delivery stops, safety risks etc. can pay the investment cost back very fast. The imagination of humans brings the only limits for the utilisation of thermographic cameras.

## 3. WHAT DOES THE USE OF IR CAMERA COSTS?

The high investment cost of IR camera has been for a long time the main reason for the limited utilization of it. Nowadays the price range is quite large depending of the camera properties. A small and simplified camera costs below 15 000 € (one example in picture 1) and better-equipped camera costs over 60 000 €. Even the simplest ones have enough properties for the most users.

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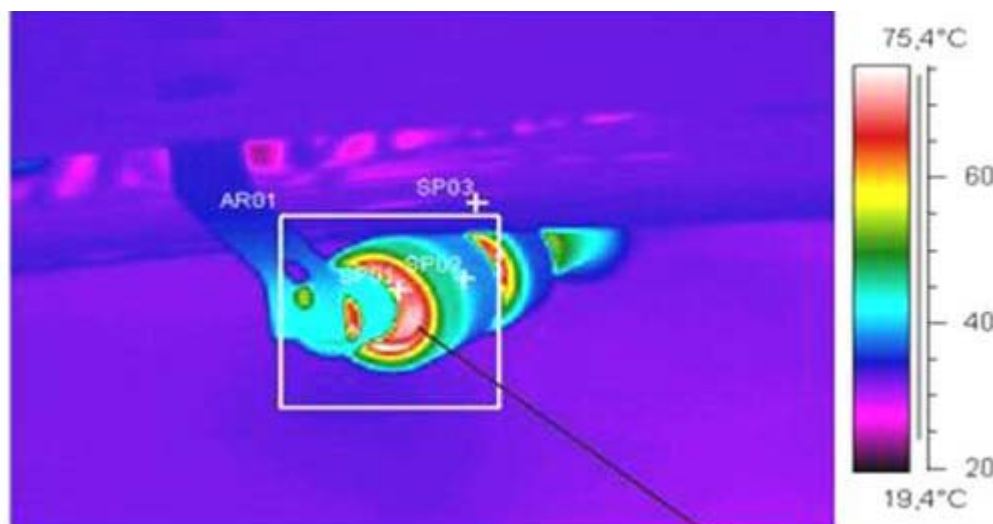
**Picture 1.** FLIR ThermoCAM® E2 infrared camera.

Renting of IR camera is also a good option. Need for the use can be limited though the year and therefore many try to avoid the investment. With a renting costs around 1 000 €/week many risk areas can be found in a very costs effective way. From the safety point of view an own camera is the best option or at least it should be possible to get one rather in minutes than in hours when it is suddenly needed.

When the investment has been done the major part of the costs comes from the salaries of the personnel that use it.

#### **4. PREVENTIVE MAINTENANCE**

In preventive maintenance target is usually to use some resources (manpower, money etc.) for the preventive actions and by this get savings in maintenance costs in case of sudden breakdowns, prevent accidents etc. Some time is usually spent for the measurement of temperature profile of electrical motors, cable trays, conveyer roller (example in picture 2) etc. with a help if IR camera. When these measurements are done in frequent intervals malfunctioning areas can be found and repaired.



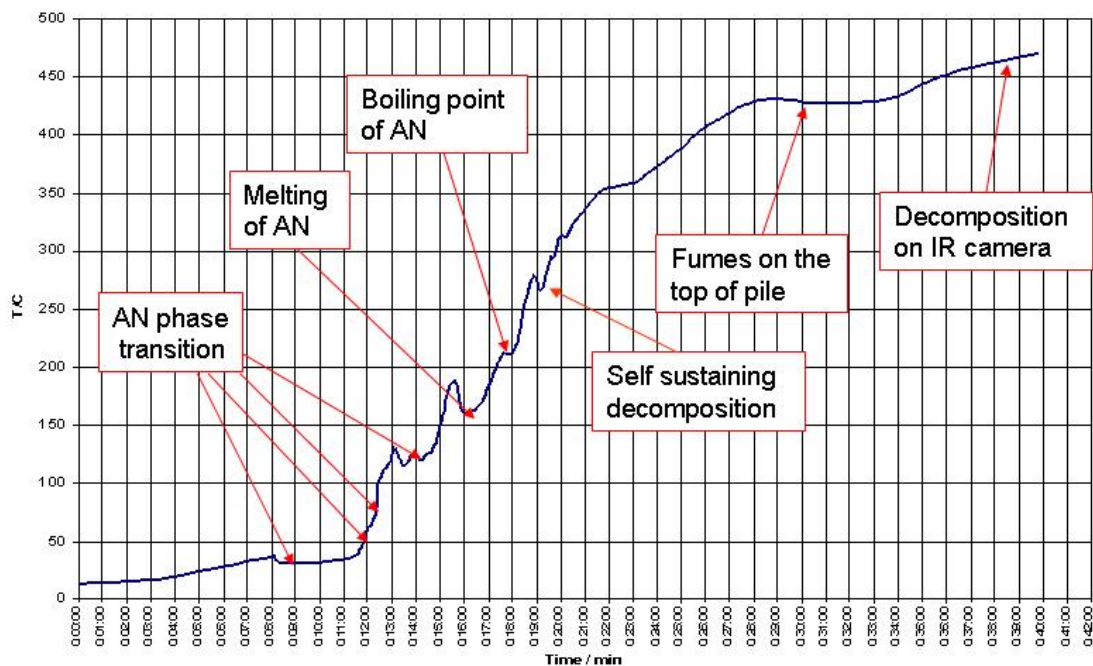
**Picture 2.** Hot bearing of a conveyer roller.

## 5. DECOMPOSITION DETECTION AND FIRE FIGHTING

A test was done in Kemira GrowHow Uusikaupunki plant during November 2003. Target of this test was to test if thermographic camera could be a useful tool for the detection of decomposition in early stage. Test was performed by own personnel and with the help from local fire brigade.

A fluorescent lamp was covered with about 400 kg of 20-7-10 MOP, which was sensitized with manganese sulphate to increase the burning speed. PT100 temperature probe was installed close to the lamp to be able to follow the development of the temperature inside the pile after the lamp was turned on. In the temperature vs. time curve it is clearly possible to see the ammonium nitrate phase transition temperatures, melting point and decomposition/boiling point of ammonium nitrate (picture 3) during this test.

Even that after 26 minutes the temperature rose to more than 400 °C no NO<sub>x</sub> gases could be seen on the top on the pile. Also the temperature of the pile shown by IR camera was around 11 °C. After 29 minutes some fumes was seen on top of the pile. The visibility started to be worse and at the time when hot decomposing slurry started to come through the pile the visibility with eyes was zero and first time during the test new "eyes" came into use. This happened after 38 minutes from the start of the lamp.

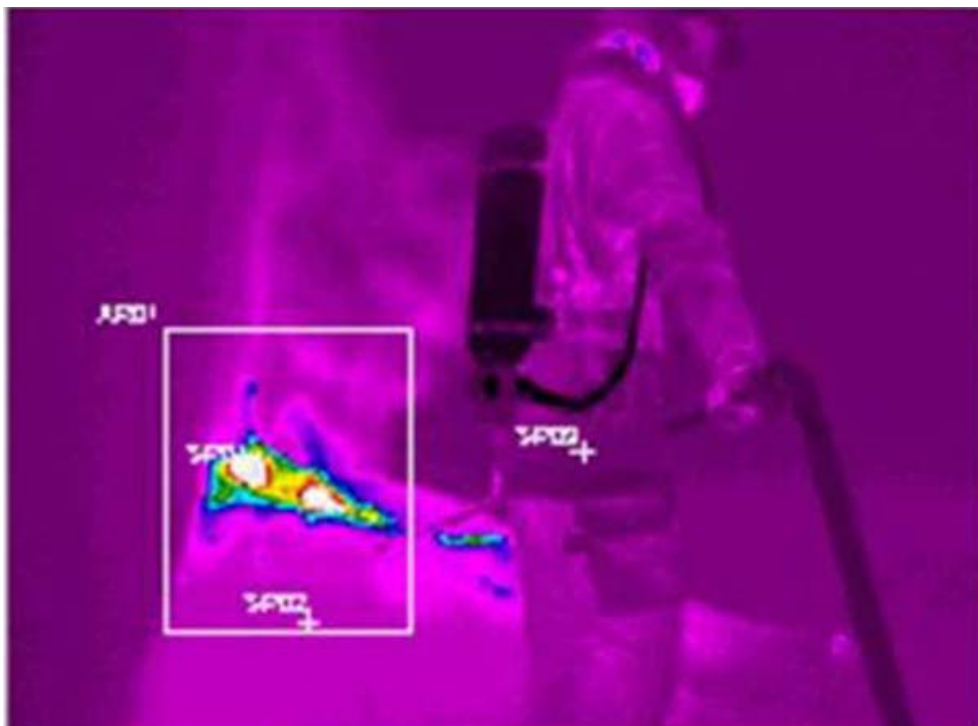


Picture 3. Temperature inside fertiliser pile vs. time.

When the decomposition did not happen in closed and insulated area it was very easy to locate and follow it with IR camera. Poor heat conductivity of fertiliser caused the situation where nobody could have realized the decomposition before it was already rapid. This is a fact that should be taken into account when doing fire fighting.

During the presence of NOx gases it was very easy to locate people inside the gases with the help of IR camera. This is very important in case of finding people who cannot find out themselves and/or has lost their consciousness. Also fire brigade can utilise the IR camera as a helping tool in fire fighting. Someone with a camera can guide firemen inside the decomposition area and help them to find out the spots where the heaviest decomposition occurs. In this test firemen used Victo Lance pipe (pipe which penetrates into a pile and sprays water there) and they were guided with IR camera (picture 4).

Possibility to locate decomposition from the other side of concrete wall was also studied, but based on this test it was not possible.



**Picture 4.** Use of Victor Lance pipe for decomposition fighting.

## 6. CONCLUSIONS

Thermographic camera is very powerful tool in preventive maintenance. Well-planned preventive maintenance rounds with IR camera together with good housekeeping can eliminate many risks before they start to cause problems.

If decomposing area is well insulated from surroundings it is also difficult to locate it with IR camera. When hot decomposing mass is in open area it can be located easily with the camera. When the decomposition is starting, normal human senses are still very useful ones to be used in check rounds.

IR camera is useful tool for firemen for detecting people inside NOx gases and for exact location of decomposition. When human eyes do not see anymore IR camera will bring lot help for the fire fighting.