Application Report No. A 90-5e

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High Pressure Water Inhibits Emission of Heavy Gases

The companies BAYER and KAMAT have developed a system to reduce the dangers involved when heavy gases are unintentionally emitted. Using water at high pressure, or steam, a protective wall of up to six metres in height is built up. What appears to be a "high-tech" development is, in fact, an ingenious way of applying standard technologies.

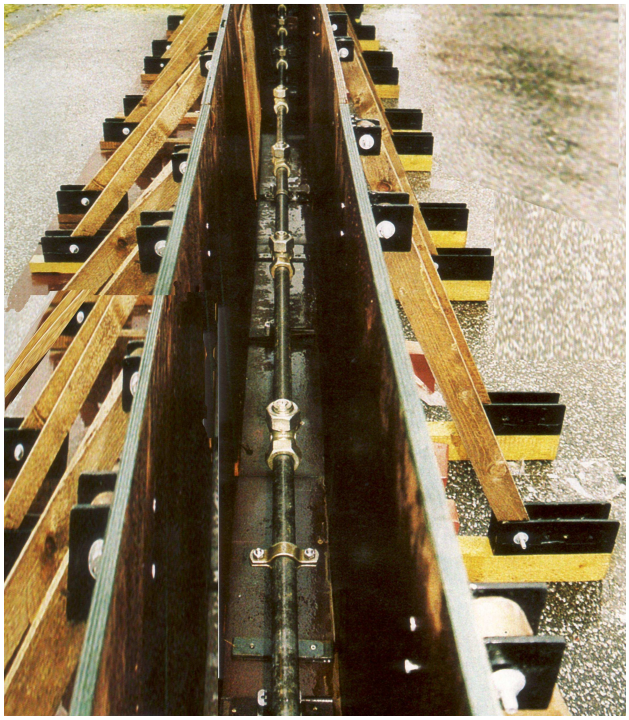
In spite of utmost precautions in the planning stages and ultimate construction and operation of plants for potentially explosive and poisonous gases it is impossible to completely eliminate the possibility of their being released inadvertently. In fact, real "lakes" of heavy gases can develop, which can even become ignited from a distance of several dozen metres.

The chemical industry uses a variety of methods to overcome the negative effects of gas blow-outs. The technologies most often applied entail the use of water or steam, depending on availability, with the aim of diluting gas. These are described below:

Water Shield:
Using this mobile solution, water at a pressure of four to five bar rebounds from a shield and forms a water fan. Although this system has the advantages of flexibility and low pressure it also has some serious disadvantages: High water consumption; low rate of dilution due to large-sized droplets; takes five to ten minutes' time to build up.

Monitor:
A fire-brigade nozzle generates a vertical fan-like water jet. Although this solution uses less water per metre than the water shield technique the disadvantages are more or less the same. In addition, the degree of dilution is even lower.

Water and Steam Curtains:
As opposed to the two mobile methods described above, a stationary system is also available. The advantage of such a fixed installation is that water or steam at a low pressure (four to five bar) can build up a protective curtain without any time lag. The disadvantages of this method: Low rate of dilution due to large droplet size. In addition, the single nozzles do not provide a complete protection so that gas is able to pass through the "wall" in an undiluted state.



Test Set-up: A provisional construction is used to simulate the function of the Water Safety Wall when sunk into the ground.

The Answer: The KAMAT Water Safety Wall

The best solution to overcome the disadvantages of the mobile and stationary systems described above is the "Water Safety Wall". Experts
arrange the fan-jet nozzles at a depth of up to 70 cm in a channel and these nozzles are supplied with water from a high pressure pump, at a pressure of 50 to 200 bar. The advantage of such a system using high pressure water lies in the fact that the Water Safety Wall needs only a fraction of the water volume (less than 30 litres per minute and metre) whilst achieving increased separation and dilution effects.

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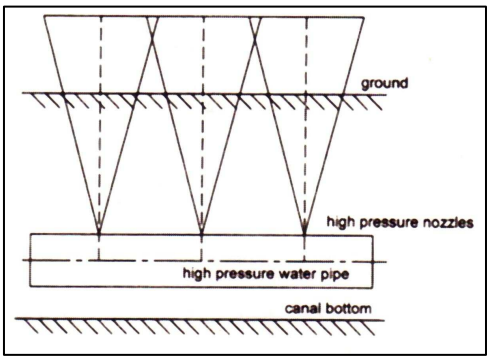

Test set-up in action:
Build-up of a protection wall up to 6 m in height, at 200 bar working pressure.

Principal sketch:
Shows the arrangement for the set-up of the Water-Safety Wall.

What about the safety aspects?

Due to the fact that the nozzles are not located on the ground but are situated below ground level in a channel, a worker can escape through the Water Safety Wall, even at a water pressure of 200 bar, without being injured and without stumbling over any additional hazard.

Even if steam at five bar pressure is used instead of water there is no danger of personnel being injured (danger of scalding if in direct contact with the pipe) since the danger is eliminated when the steam expands, and this takes place just a few centimetres above the exit point.
Initial trials were carried out in cooperation with the Bayer Company Fire Brigade at the Bayer company premises and these first tests already proved the reliability of the patented invention. Even when there was a side wind of four to five metres per second, the Water Safety Wall set up at a pressure of 150 bar succeeded in reliably stopping the coloured smoke, used to simulate the heavy gases, right in front of the "Wall". In comparison, the conventional methods proved to be totally inadequate in coping with side winds, which further tests clearly showed. Even at considerably lower pressures, the protective effect of our system, where the nozzles are located below the ground, is certainly more efficient.
The controls of the system can be individually designed. Generally it can be said that a fully-automatic solution is not recommendable due to possible occasional false alarms raised by the multitude of sensors. A system where a person in the control centre is responsible for assessing the false alarms before starting the Water Safety Wall is preferable.

KAMAT High Pressure Unit

Diesel-driven high pressure pump units are the best choice for this application as they work independently of the electricity network. KAMAT recommends a trial run on a monthly basis to check that the system is working properly. To be on the safe side, KAMAT installs an additional pump on the unit as a stand-by.
The water quality available from the public mains supply is absolutely acceptable - our pumps work reliably when there are dirt particles of up to 250 micrometers. It may be necessary to consider a filtration system if water is left stagnant in any transmission lines for a longer period.

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