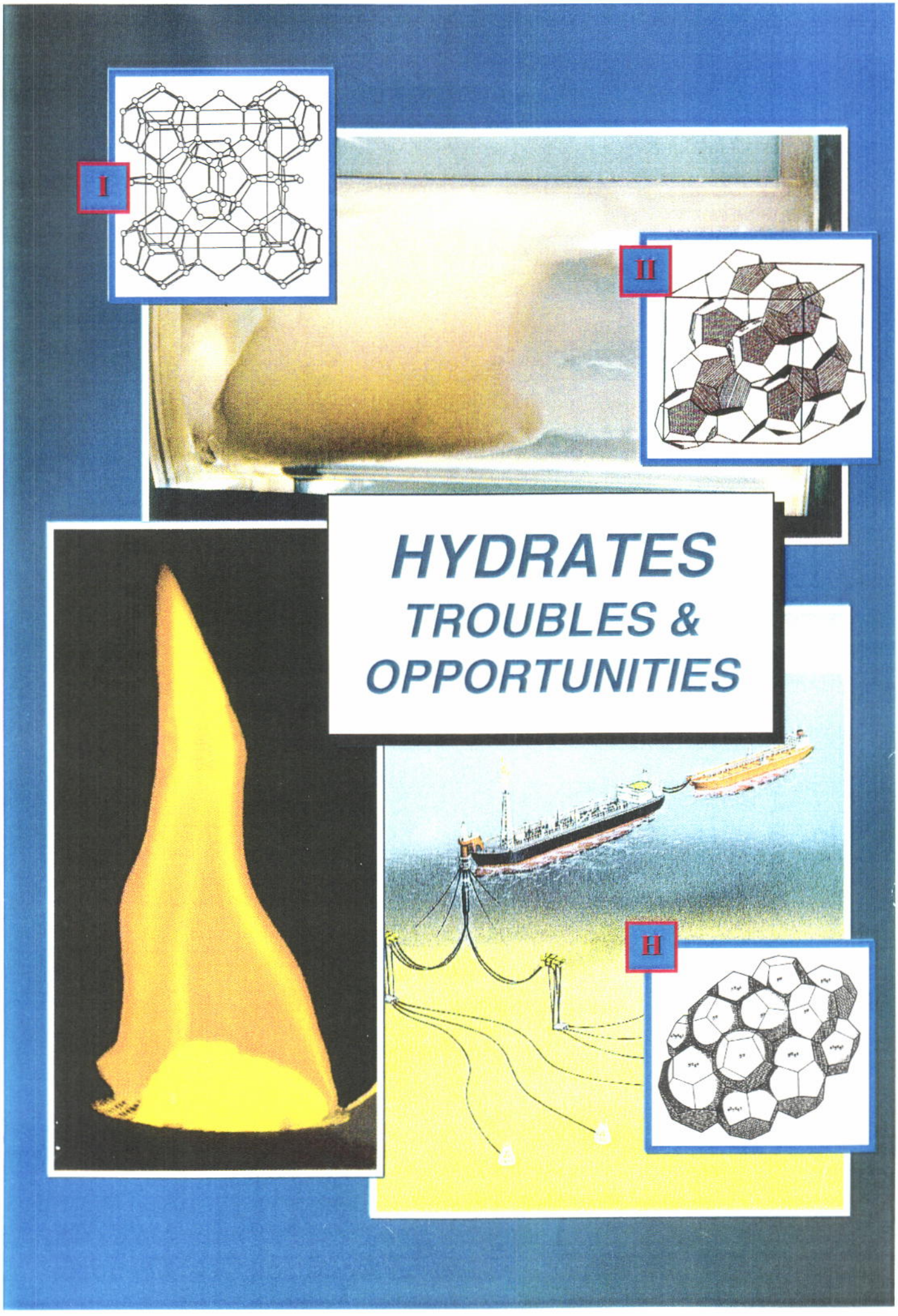
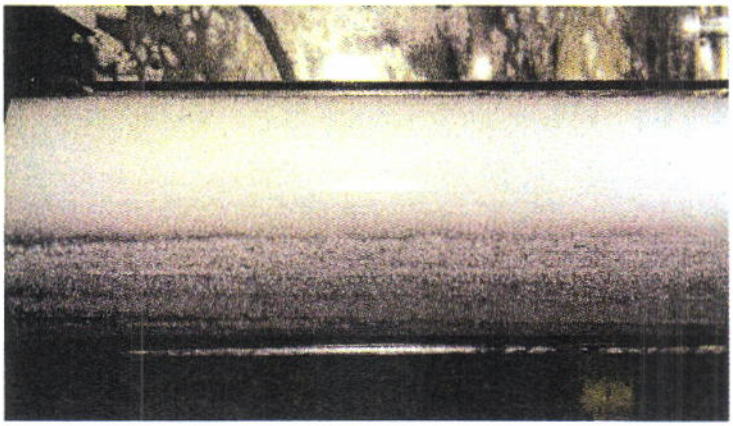

I
II
HYDRATES
TROUBLES &
OPPORTUNITIES
H

The gas hydrates are deposits similar to ice. They occur when hydrocarbons come into contact with water at specific T and P. Gas, condensates and oil can produce hydrates in cold habitats (ex. deep waters, seabed conditions T=3÷4°C; sealine working pressure 70÷80 bar).



HYDRATE DEPOSITION ON PIPE WALL
(SINTEF-Annual report 1992
Hydrate formation and behaviour in flowing fluids)

1 - HYDRATES

Gas hydrates are crystalline solids similar to ice, consisting of water (about 85% of the total) and gas (e.g. methane, nitrogen, helium Fig. 1)[1-10]. These compounds are stable at high pressures and low temperatures.
The above conditions may occur in different points of the oil production system: pipelines, production facilities.
They may occur in subsea lines (e.g. North Sea, Gulf of Mexico) when oil and/or unstabilised wet gas are transported together (multiphase). In fact, the pressure in these pipelines is usually high and the temperatures low - being close to the seabed temperature.

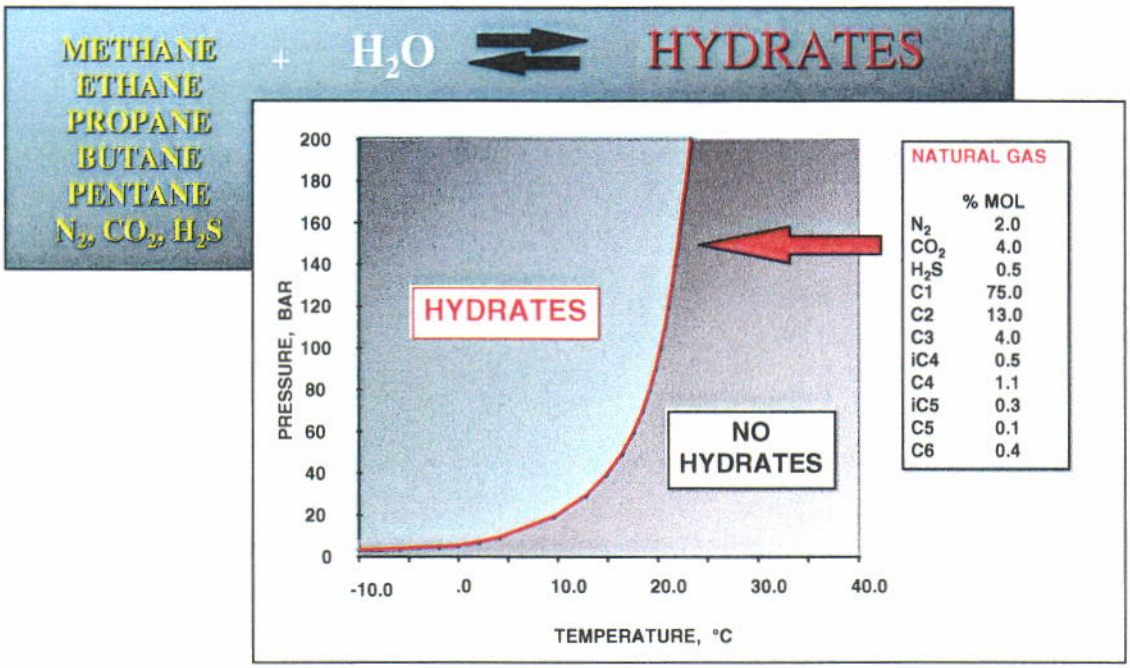


FIG.1 - STABILITY PREDICTION OF HYDRATES IN A GAS PIPELINE

Another example of hydrate occurrence is during the storage of gas in underground caves (Nixdorf and Oellrich 1996)[11]. Usually the temperature inside these caves is too high to enable the formation of hydrates, however the dry gas which is injected may become saturated with water. As the wet gas is collected during winter, temperatures close to the surface may be low enough to promote the formation of hydrates. The first reported case of hydrates forming outside the lab dates back to 1934 (Hammerschmidt)[12] and involved the attempt to distribute gas saturated with water during winter.

Gas hydrates are also present in the natural environment, below ocean beds and in the permafrost.

The structure of hydrates, their chemical - physical characteristics and thermo-dynamic behaviour have already been widely studied. However, as concerns the formation of these compounds, a great deal still has to be discovered about the kinetic aspects which govern the reaction and control the rate of formation.

The technologies related to hydrates have mainly been developed as a result of knowledge on the thermodynamics of these compounds. Thermodynamics make it possible to identify the stability conditions of hydrates in various compositional states (description of phase equilibria with various types of hydrocarbon mixtures) and to plan chemical treatments for inhibiting these products (calculation of the required amounts of methanol and glycol for inhibiting the hydrate formation, description of the phase equilibria in the presence of inhibitors).

To sum up this brief look at the main characteristics of hydrates, we shall mention a particular aspect of these compounds: an ice-cube is stable for a fairly long time - several hours - at ambient pressure and at temperatures below 0°C.

In fact the decomposition process of hydrates is slow. The most interesting aspect of these compounds is when the hydrocarbon gases, which are released through decomposition, are burnt. It is as if an ice-cube, which the gas hydrates resemble, were to burn (Fig.2).

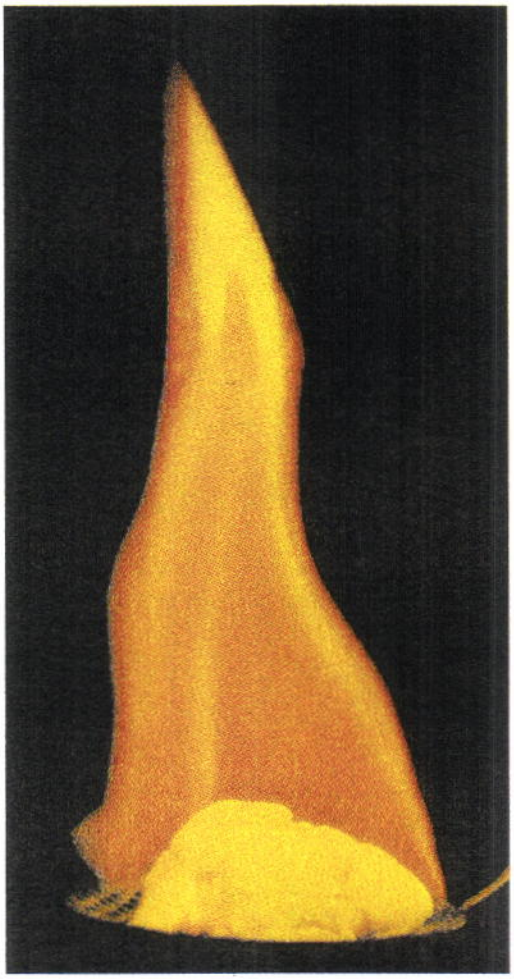


FIG. 2 - METHANE HYDRATE COMBUSTION
(M.BYLOV - Ph.D. Thesis - 1997
Institut for Kemiteknik-Danmarks Tekniske Universitet)