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GAS DIFFUSIONS IN FLEXIBLE PIPELINES.

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ABSTRACT

This presentation describes a model used to study gas diffusion through layers of flexible pipes by time. The temperature gradient pipe is considered as temperature dependent permeability rates. This model is coupled with a calculation that indicate changes in pressure and volume of vapors resulting in the annular space.Associated mathematical models and methods for solving the results obtained are presented in Math Soft with a user-friendly interface that helps in data entry and processing results.In this presentation will show the possibilities of this software

Keywords*—rehabilitationpermeability, diffusion, pipelines, polimer, riser.*

I. INTRODUCTION

The offshore oil industry, hoses and raizereleare made with polymers with internal and external coatings, which provides fluid flow through the inner and outer insulation in relation to the marine environment. These polymers have a certain permeability to gas that can facilitate the reduction of the potential damage mechanisms of the life of the steel layers located between the pipe and the outer shell of polymer. The destruction mechanisms associated with water condensation, therefore, they must be removed, [1].

II. OPERATING ENVIRONMENT FOR FLEXIBLE PIPE AND RISER

They are considered deepwater activity in terms of oil, waters deeper than 400 m; 1 500 m is considered ultra deep water (over 1 600 m after MMS Mineral Management Service, USA)

Oil industry operators are turning to large water depths, because there are significant resources that ensure high yields. Some oil wells in these areas can produce 8000 m3 / day crude oil production justifying additional costs and risk.

Projects operating from premises situated in water depths of 2000 m in the Gulf of Mexico, Brazil and West Africa Offsore were unimaginable not long ago. A large number of wells have been drilled at depths of water; record of 10 400 ft (m 3174) was passed in February 2013 in the Indian Ocean.The most important aspects in production wells located in deep water depths are related to high water, but also on the bottom, the hostile environment in which it operates: waves 30 meters high; Winds exceeding 80 knots (148.2 km / h); low air temperatures: -15 ° C; Sea water temperature: 0 ° C; marine currents 3 knots (5.5 km / h) etc.

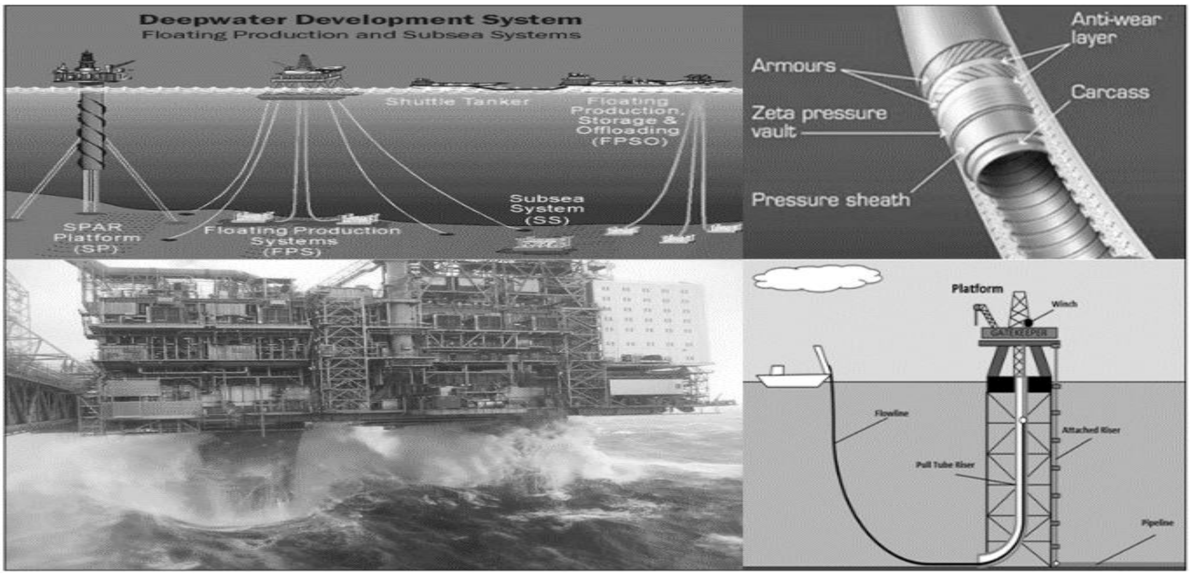

Fig.1 Flexible pipes operatingand production risers [3]

Column production or production riser is the portion that lies between the host plant surface and the seabed near the home of an installation depth. Discharge sizes are from 3 to 12 in (76.2 mm to 304.8). in diameter. The length of the riser is dependent on water depth and configuration of the column, which may be vertical or a variation waveform. Derivatives may be flexible or rigid and contained in the operating area of a fixed or floating platform installation type

III. Structure flexible pipe. General items

Unbounded flexible pipes over the last 30 years were a key component in the production of oil and gas offshore. They represent an alternative to rigid steel pipes where they have the advantage of a quick installation and the potential adaptation de route. These benefits often make unbounded flexible pipes, a more economical solution than rigid steel pipes.

Successful exploitation of the majority of floating production systems depends on good performance systems dynamic flexible riser or jumper. The limits are consistently higher pressures and higher temperatures for deep waters, leading to increasing demands on the performance of pipe components. Layers of steel materials are decisive for their behavior in acidic environments static and dynamic applications.

Unbounded flexible pipe structure requires that the steel is in direct contact with the fluid product. The medium is determined by permeation of small molecules (mainly H2O, CO2, H2 and CH4) by lining the polymer. Predictions therefore operating environment is a key issue for the prediction, design and service life of flexible pipes.

Unbounded flexible pipes are made of concentric layers of polymer material and steel. In order to preserve the flexibility of the construction of the pipe layers are not bonded together. The following figure shows a typical cross section of a flexible layers depicting typical. Different types of flexible, [4], [5] unbounded pipe may omit some of the layers. It is presented in the most general description of each of the major layers, Figure 2.

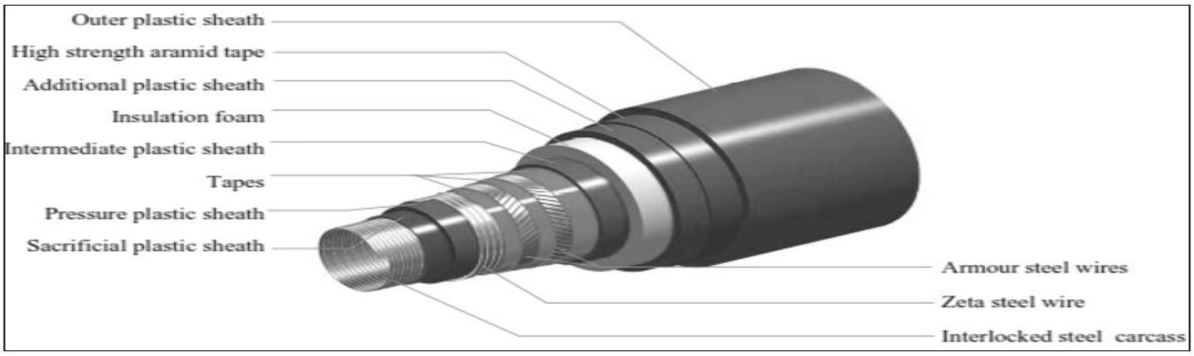

Figure 2 – Deneral description of each of the major layers

Steel Carcass An interlocking layer made of a stainless steel strip. The casing prevents the collapse of the inner hull and provides mechanical protection against gear (pigging) and abrasive particles. Quality stainless steel structure is studied in detail, but is outside the scope of this paper research.

Inner thermoplastic sheathA polymer layer extruded ensure the integrity of the internal fluid. Common types of polymers are polyethylene (PE), cross-linked polyethylene (XLPE), polyamide 11 (PA11) and Polivinilien fluoride) PVDF.

Pressure armor layerA number of layers composed of helically wound wire form C of steel and / or metal strips. The layers of reinforcement provide resistance to radial loads.

Fittings traction A number of structural layers consisting of helically wound flat steel wire. Layers are against and wrapped in pairs. The layers provide resistance to axial loads. External thermoplastic Sheth (A layer of extruded polymer) function is to protect steel components pipe from the outside (often seawater) and to provide mechanical protection.

Nomenclature: PA11 polyamide 11:PE polyethylene: PVDF poly(vinylidene fluoride) C concentration (cm^3/cm^3): D diffusion coefficient (cm^2/s)

IV. FACTORS INFLUENCING THE INTEGRITY AND LIFE OF

Interior factors affecting the integrity riserare: fatigue fracture of steel casing, deformation housing, erosion figure 3a, influence of thermal variation, aging in action, chemical factor, temperature, diffusion in the annular space of H2S / CO_2 figure 3b, fatigue protective coatings, the formation of hydrates.

External factors affecting the integrity riser are: wear resulting from the interaction with the plant surface and submerged constructive elements, normal wear constructive materials, interacting with other lines submerged, deterioration protective outer covering Corrosion, hydrogen cracks action.

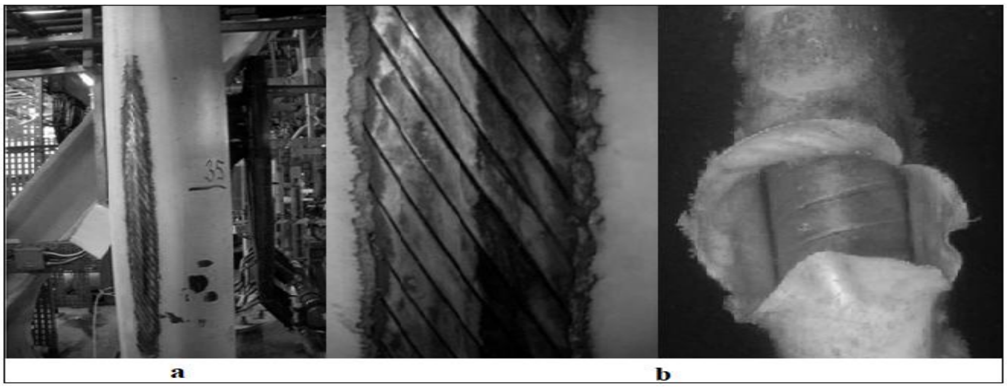

Figure 3 a)Damage to the outer covering contact with the production plant; b)Explosion outer covering due to accumulation of gas in the annular space, [3]

V. GAS DIFFUSION – PERMEABILITY

It is well known that polymeric materials can be regarded as watertight only to a certain extent. With a difference of partial pressure of a fluid in a polymer membrane (liner) will result in higher penetration fluiduluide pressure to low pressure. The mechanisms of permeation polymers are outside the scope of this work are described extensively in the literature. Flexible pipe, coatings characterized by migration of gas permeability inside the pipe and the outer casing annulus. The offshore oil and gas production of molecules of interest are significant and methane (CH_4), carbon dioxide (CO_2), hydrogen sulfide (H_2S) and water (H_2O), [2].

Manufacturing companies arealizat research programs in order to determine the characteristic phenomenon of diffusion constants: permeability diffusion coefficient, solubility, the polymers used as material for deconstruction to flexible pipes. In addition to the main layers, are included more polymer layers to prevent wear between the structural layers. The strips of insulation with a low thermal conductivity may be used, for example, between the main reinforcement and the outer jacket, in order to obtain specific properties of the pipe insulation.

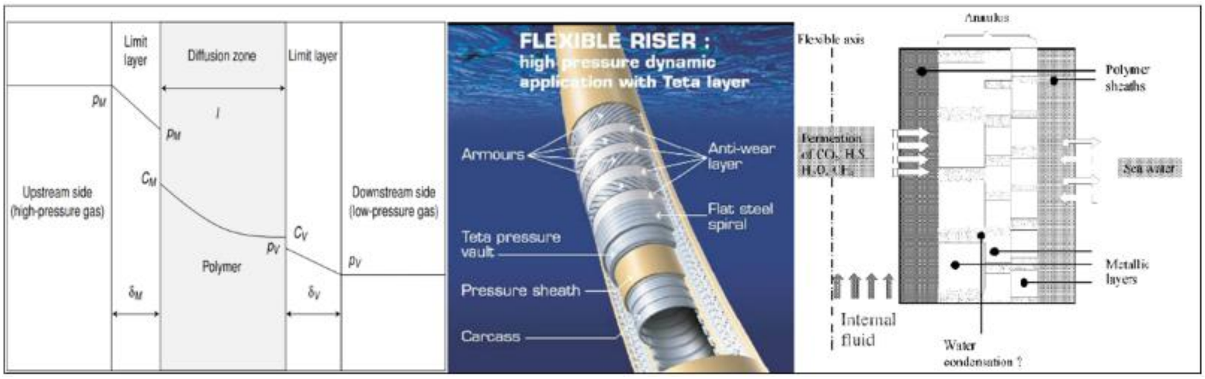

Figure 4 – The model of an element wire, [2]

Understanding the damage mechanisms in polymer coatings during gas decompression goes through the knowledge of gas transport phenomena in polymers, by studying the influence of gas absorption on material properties, and by modeling the behavior of the material during a decompression. The mathematical theory of diffusion (Crank, 1968) in an isotropic system is based on the hypothesis of the proportionality between the scattering flux of the molecules (which is the quantity of species crossing a membrane per unit time and surface) and the concentration gradient between the two faces Of the membrane. It is Fick's first law [2]:

$$J = -D\,\frac{\partial C}{\partial x} \qquad (1)$$

where:

J is the scattering flow of the molecules

D - diffusion coefficient (cm2 / s); D = D (C, T, p)

C – concentration

The permeation, [4]. [5] Table 1, of methane and carbon dioxide plasticized polyvinylidene fluoride water (PVDF) and plasticized polyarnid 11 (PA11) was measured for a number of temperatures and pressures with testing devices.

Table 1

PERMEATION COEFFICIENTS FOR METHANE AND CARBON DIOXIDE THROUGH PLASTICIZED PVDF FOR TWO DIFFERENT GAS MIXTURES AT 120°C.

	Permeation coefficient, P (cm²/s·bar)		
Gas mixture	Methane	Carbon Dioxide	Pressure
$97\%CH_4 - 3\%CO_2 - H_2O$	$2.2\cdot10^{-7}$	$8.4\cdot10^{-7}$	25 bars
$75\%CH_4 - 25\%CO_2 - H_2O$	$2.1\cdot10^{-7}$	$8.3\cdot10^{-7}$	25 bars

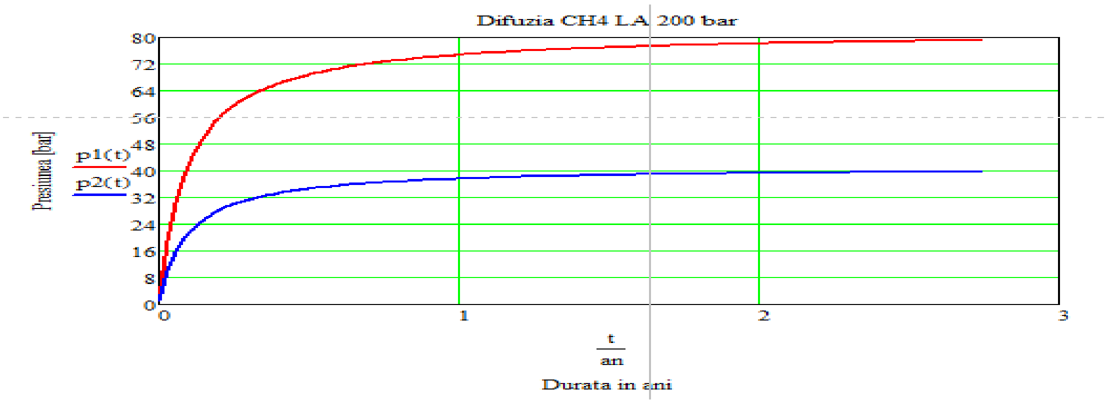

Figure 5 a

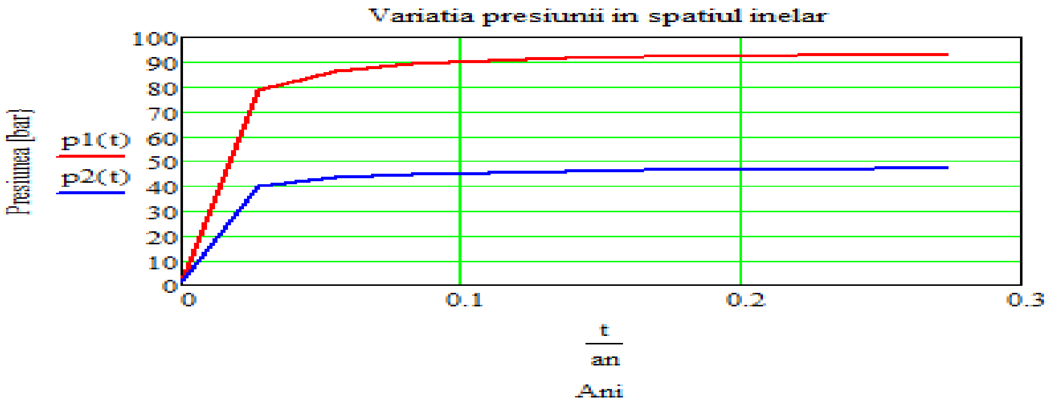

Figure 5 b

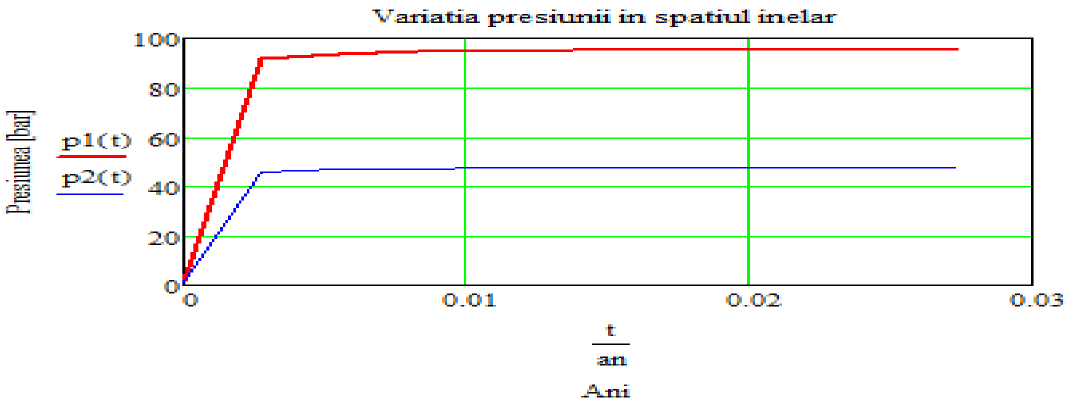

Figure 5 c

Figure 5 – Numerical simulation for a) difussion CH_4;b) difussion $CO_{2,}$;c) difussion H_2O

CONCLUSIONS

To avoid gas diffusion effects in terms of maintaining balance in corrosive environment created by their penetration is required ventilation gas in the annulus. Establishing the ventilation status of layer fluids and observing the conditions considered to limit the upper end: continuous ventilation or - Intermittent respectively at atmospheric pressure ventilation or - sub-atmospheric (vacuum). Relationships and mathematical equations of the model proposed for the analysis and design of ventilation for independent parameters of time (geometric) while those for addicts (hydraulic parameters). works constitute a separate objectives.

Acknowledgment

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