“RESEARCH ON THE TECHNOLOGICAL FACTORS THAT DETERMINE THE INCREASE OF COILED TUBING DURABILITY”

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S U M M A R Y

The main issues studied in the PhD thesis are the collapse and fatigue behavior of coiled tubing used in the petroleum industry, for which the correct estimation of the life span and factors that influence it are essential in order to avoid technical accidents.

In Chapter 1, entitled *Current status of construction and operation of* the *coiled tubing unit*, on the basis of extensive literature review and information obtained from direct users, both the constructive and functional characteristics of the coiled tubing unit are presented. It is also analyzed the progress made to date in standard sizes and mechanical characteristics of coiled tubing. In this chapter, it is also included a presentation of the main technological operations that are carried out in wells using coiled tubing, which shows its operating requirements. Another focal point was the analysis of the structural characteristics and operational requirements of coiled tubing equipment, emphasizing standard sizes, materials and mechanical characteristics of usual operating coiled tubing.

In Chapter 2, entitled *Stresses and the main forms of failure of coiled tubing*, are analyzed the main operating stresses of coiled tubing. It is also designed an original experimental program on the behavior of real tubing for cyclic bending together with internal pressure, performed on a modernized testing stand for low cycle fatigue. In this chapter, it is also presented the methodology and the results of the original research about the local buckling of the coiled tubing under external pressure (collapse). There are analyzed the main relationships recommended in the literature for calculating critical collapse pressure with and without axial tensile force and it is also developed a test procedure for collapse pressure determination, consisting of upgrading a specific testing facility, designing and adapting a device for axial tension.

Chapter 3, entitled *Experimental research on fatigue characteristics of coiled tubing*, was dedicated to theoretical and experimental analysis of the following aspects: determining

cyclic stress-strain curve of the material (Ramberg – Osgood) and of the cyclic strain-life curve (Manson – Coffin) on the basis of the material characteristics obtained by tensile testing (the concept of Uniform Material Law) as well as experimentally (on a testing equipment for low cycle fatigue); making an experimental program aimed at determining the number of bending cycles to failure, with and without internal pressure, using real tubing samples with initial geometry and with a stress concentrator artificially made by milling/cutting, in order to determine the number of cycles for crack propagation of initiated at an acceptable size defect.

In Chapter 4, entitled *Developing a method for the assessment of the durability of coiled tubing*, the following aspects are presented and analyzed: developing a method for estimation of the coiled tubing durability based on the modern concept of calculating the total number of cycles for initiation and propagation of a fatigue crack starting from a pre-existing defect, determining the fatigue life of new coiled tubing and those with an artificial defect, by using material characteristic specific for the calculation of low cycle fatigue, obtained analytically and experimentally.

Chapter 5 presents the main *Conclusions, original contributions and research directions* of the thesis, developing the conclusions of each chapter. The main research directions proposed refer to continuing the research on tubing made of titanium alloys, nickel and composite materials, taking into account the influence of aggressive environments and researching the local buckling under the combined action of external pressure, axial tension and bending moment.