

ABSTRACT**Sucker Rod Pumping Design for Wells Producing
Highly Viscous Crudes****Leslie Kennedy**

Sucker rod pumping installations are currently designed using the method provided in the API recommended practice, API RP11L [1]. This technique was derived in 1954 by Sucker Rod Pumping Research, Incorporated. The non-dimensional design curves presented are based on the best interpretation of average values and are not applicable in certain unusual pumping conditions. The most important of these are:

- (a) Slanted or crooked holes
- (b) Very viscous fluid
- (c) Excessive sand production

Unfortunately, Trinidad has a large number of wells which produce highly viscous crudes. At present, no systematic method is used to design the installations used in these wells. Designs are based on the vast experience accumulated by the local industry through more than 50 years of sucker rod

pumping. The use of this "experience" method to design installations has been proven deficient in three critical areas:

- (a) Inability to handle situations where crude viscosities may vary considerably from the average. This deficiency is highlighted by the occurrence of instances of floating rods and leaking tubing when attempting to pump certain wells.
- (b) Inability to calculate unit design parameters such as peak torque, maximum load and the rod stress range.
- (c) Inability to achieve the well's potential.

A new technique to resolve these difficulties is now presented. The method uses the one-dimensional damped wave equation of Gibbs [2] in conjunction with the viscous damping coefficient of Lea [3] to simulate the behaviour of the rod string through a totally mathematical approach. The model is used to generate the maximum pump speed possible without the occurrence of floating rods. The downhole tubing pressure and the unit and rod string design parameters are computed at this maximum speed. The unit, tubing and rod string can now be properly selected.