Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **29 (2022)** 385-401
Copyright ©2022 Watam Press http://www.watam.org

ON THE LONG TIME BEHAVIOR OF A VISCOELASTIC PLATE EQUATION WITH A VELOCITY-DEPENDENT MATERIAL DENSITY AND A LOGARITHMIC NONLINEARITY

Adel M. Al-Mahdi [1]

[1]The Preparatory Year Math Program
King Fahd University of Petroleum and Minerals Dhahran 31261, Saudi Arabia
E-mail: almahdi@kfupm.edu.sa

Abstract. In this paper, we are concerned with the following problem

$$|u_t|^\rho u_{tt} + \Delta^2 u + \Delta^2 u_{tt} - \int_0^t h(t-s)\Delta^2 u(s)ds = \alpha u \ln|u|.$$

We use the multiplier method, some logarithmic inequalities and some properties of integro-differential inequalities to establish a general decay result for the solution of this problem. We minimize the conditions imposed on the relaxation function h by assuming that h satisfies

$$h'(t) \leq -\xi(t)H(h(t)),$$

where the two functions ξ and H satisfy some conditions. This assumption allows us to use a more general class of the relaxation functions and to obtain a more general stability result. In fact, our results generalize, extend and improve many results in the literature.

Keywords. Stability, Logarithmic Sobolev inequalities, Viscoelasticity, Plate equation, Convex functions.

AMS (MOS) subject classification: 35L55; 35B35; 75D05; 74D10; 93D20.

1 Introduction

Viscoelastic plate equations have been studied by many authors and several stability results have been established. For example, Rivera et al. [24] studied the following problem

$$u_{tt} - \sigma\Delta u_{tt} + \Delta^2 u + \int_0^t h(t-s)\Delta^2 u(s)ds = 0. \text{ in } \Omega \times \mathbb{R}^+ \tag{1}$$

with initial and dynamical boundary conditions and a relaxation function h satisfies the following conditions

$$-c_0 h(t) \leq h'(t) \leq -c_1 h(t), \qquad 0 \leq h''(t) \leq c_2 h(t), \tag{2}$$

for some positive constant $c_i,\ i = 0, 1, 2$ and the constant $\sigma = \frac{h^2}{12}$, where h is the uniform thickness of the plate. They demonstrated that the sum of the