Dark Solitons for a Generalized Korteweg-de Vries Equation with Time-Dependent Coefficients

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We consider the evolution of long shallow waves in a convecting fluid when the critical Rayleigh number slightly exceeds its critical value within the framework of a perturbed Korteweg-de Vries (KdV) equation. In order to study the wave dynamics of nonlinear pulse propagation in an inhomogeneous KdV media, a generalized form of the considered model with time-dependent coefficients is presented. By means of the solitary wave ansatz method, exact dark soliton solutions are derived under certain parametric conditions. The results show that the soliton parameters (amplitude, inverse width, and velocity) are influenced by the time variation of the dependent model coefficients. The existence of such a soliton solution is the result of the exact balance among nonlinearity, third-order and fourth-order nonlinear dispersions, diffusion, dissipation, and reaction.

Key words: Dark Soliton Solution; Convecting Fluid; Variable-Coefficient KdV Equation; Solitary Wave Ansatz Method.