THE LAWS OF THERMOHYDRODYNAMICS

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In this paper we give the Laws of Thermohydrodynamics, the van der Waals Thermohydrodynamic Equation and the Laws of Thermohydrodynamical Systems in Chaos.

The Laws of Thermohydrodynamics are the Laws of Thermochemistry in chemical equilibrium, so the dynamics of a thermohydrodynamical system is determined by the thermic energy and the mechanical energy.

First Law of Thermohydrodynamics. An isolated thermohydrodynamical system evolves irreversibly to the state of thermohydrodynamical equilibrium.

$$dU \to 0 \text{ as } t \to \infty$$

in which U is the energy of the isolated thermohydrodynamical system at time t.

Second Law of Thermohydrodynamics. In a thermohydrodynamical system the energy is conserved.

$$\frac{dU}{U} = \frac{dQ+dW+dE+c^2dm+d\gamma A}{Q+W+E+mc^2+\gamma A}$$

in which U is the energy, Q, the thermic energy, W, the mechanical energy, E, the electromagnetic energy, mc^2, the relativistic energy and γA, the surface tension of the thermohydrodynamical system.

Third Law of Thermohydrodynamics. In a thermohydrodynamical system the sum of the variations of the thermomechanical energy and the chemical kinetic energy is the sum of the variations of the thermic energy and the surface tension.

$$\frac{VdP+PdV+dK}{PV+K} = \frac{dQ+d\gamma A}{Q+\gamma A}$$

in which PV is the thermomechanical energy, K, the chemical kinetic energy, Q, the thermic energy and γA, the surface tension of the thermohydrodynamical system.

Fourth Law of Thermohydrodynamics. In a thermohydrodynamical system the chemical kinetic energy tends to half the Planck's constant times the characteristic frequency of the normal mode as the temperature tends to zero.

$$K \to \frac{1}{2}\hbar\nu \text{ as } T \to 0$$

in which K is the chemical kinetic energy, $\hbar$, the Planck's constant, ν, the characteristic frequency of the normal mode, and T, the temperature of the thermohydrodynamical system.

Fifth Law of Thermohydrodynamics. In a thermohydrodynamical system the variation of entropy is the variation of the thermic energy minus the flow of relativistic energy per temperature.

$$\frac{dS}{S} = \frac{dQ - c^2 dm}{T(Q - mc^2)}$$

in which S is the entropy, Q, the thermic energy, T, the relative temperature and mc^2, the relativistic energy of the thermohydrodynamical system.

Sixth Law of Thermohydrodynamics. In a thermohydrodynamical system the variation of entropy due to irreversible variations of the thermic energy is always positive.

$$dS_i \geq 0$$

in which S_i is the entropy of the thermohydrodynamical system due to irreversible thermohydrodynamical processes.

Seventh Law of Thermohydrodynamics. In a thermohydrodynamical system the entropy tends to zero as the temperature tends to zero.

$$S \to 0 \text{ as } T \to 0$$

in which S is the entropy and T, the temperature of the thermohydrodynamical system.

The van der Waals Thermohydrodynamic Equation

A differential behaviour of the van der Waals Equation on pressure in fluids arises as large variations of pressure give small variations of volume, and so, small variations of the intermolecular forces of collision, showing that the van der Waals Thermohydrodynamic Equation is

$$Pe^{aN^2/V^2}(V - Nb) + K = Q + \gamma A$$

in which PV is the thermomechanical energy, K, the chemical kinetic energy, Q, the thermic energy, γA, the surface tension, N, the molecular number and a and b, the van der Waals coefficients of the thermohydrodynamical system.

The Laws of Thermohydrodynamical Systems in Chaos

Chaos in fluids arises from the nonlinear flow as turbulence and hurricanes. Now we give the Law of Thermohydrodynamical Systems in Turbulent Flow and the Law of Hurricanes, by the Second Law of Thermohydrodynamics.

A thermohydrodynamical system in motion goes through turbulence from the linear flow. Thus, by the Second Law of Thermohydrodynamics, a thermohydrodynamical system goes into turbulence as the derivative of the translational mechanical energy with respect to the energy decrease.

Law of Thermohydrodynamical Systems in Turbulent Flow. A thermohydrodynamical system goes into turbulence as

$$\frac{dW_t}{dU} < 1$$

in which W_t is the translational mechanical energy and U, the energy of the thermohydrodynamical system.

A thermohydrodynamical system turns into a hurricane from the turbulent flow within variations of the thermic energy and the surface tension. Thus, by the Second Law of Thermohydrodynamics, a thermohydrodynamical system turns into a hurricane as the derivative of the sum of the thermic energy, the translational mechanical energy, the rotational mechanical energy and the surface tension with respect to the energy decrease.

Law of Hurricanes. A thermohydrodynamical system turns into a hurricane as

$$\frac{dQ+dW_t+dW_\phi+d\gamma A}{dU} < 1$$

in which Q is the thermic energy, W_t, the translational mechanical energy, W_ϕ, the rotational mechanical energy, γA, the surface tension, and U, the energy of the thermohydrodynamical system.