MODIFICATION OF ENERGY HYPOTHESIS FOR THE CASE OF EXPLOSIVE CHARGE

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Energy hypothesis given by Thomas (1957) is modified for the case of explosive charges of finite radius. It is found that strength of shock wave in the case of explosion by explosive charge of finite radius is less as compared to point explosion of same energy release. Moreover this method can be used directly to physical problems.

Introduction

In another paper (Singh and Bola *in press*), here after to be called as paper I, the authors have discussed propagation of shock waves in homogeneous water, using energy hypothesis deviced by Thomas (1957) c.f. (Bhutani 1966). Here it was assumed that energy is released at a point. But in actual practice it is known that explosive charge has definite size, and energy is not released at a point. Actually point explosion is an hypothetical explosion.

In the present paper we have modified energy hypothesis for explosive charge of finite radius. Effect of gas bubble is neglected and it is assumed that whole of available energy is used in the propagation of shock wave.

Variations of pressure, specific volume fluid velocity and shock velocity are compared with those of paper I and it is found that decay of shock parameters is more in the present case as compared to earlier case.

Discussion of the Problem

We assume that a spherical charge of RDX/TNT (60:40) of radius a is fired in water. An energy of Q calories is released, due to which a shock wave is produced and propagates outward. If E^* is the total energy of water then

$$E^* = \frac{1}{2} u^2 + E \qquad \ldots \quad \ldots \quad \ldots \qquad (1)$$

where E is the internal energy of water per unit mass and $\frac{1}{2}u^2$ is the kinetic energy per unit mass. Then it was shown (Singh and Bola *in press*, Bhutani 1966) that

$$E_2^* - E_1^* = \frac{3\,a\,Q}{4\pi\,\rho_2\,R^3} \qquad \ldots \quad \ldots \quad \ldots \qquad (2)$$

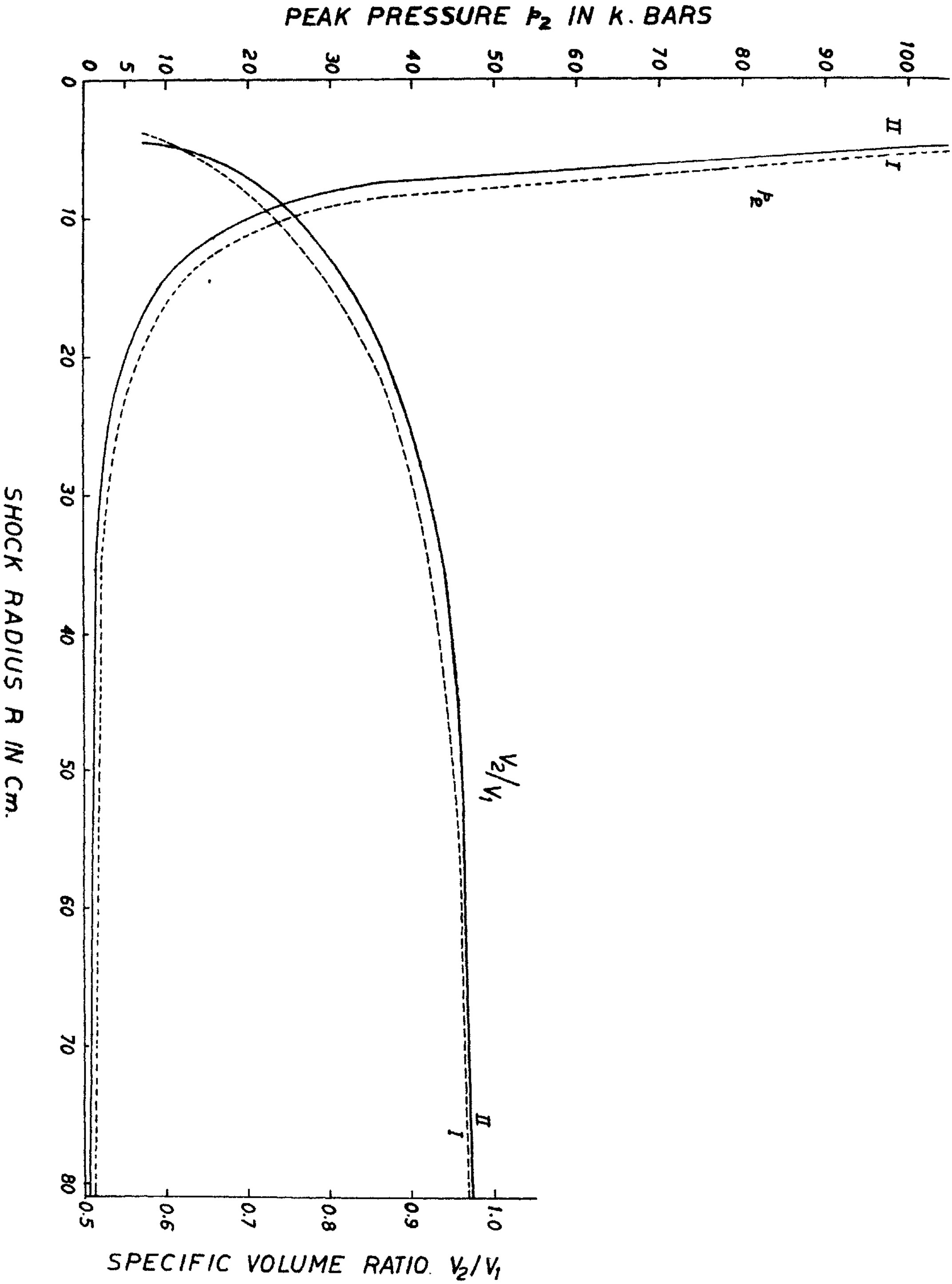

FIG. 1. Variation of peak pressure and specific volume versus shock radius R. Dashed lines are those of paper I.

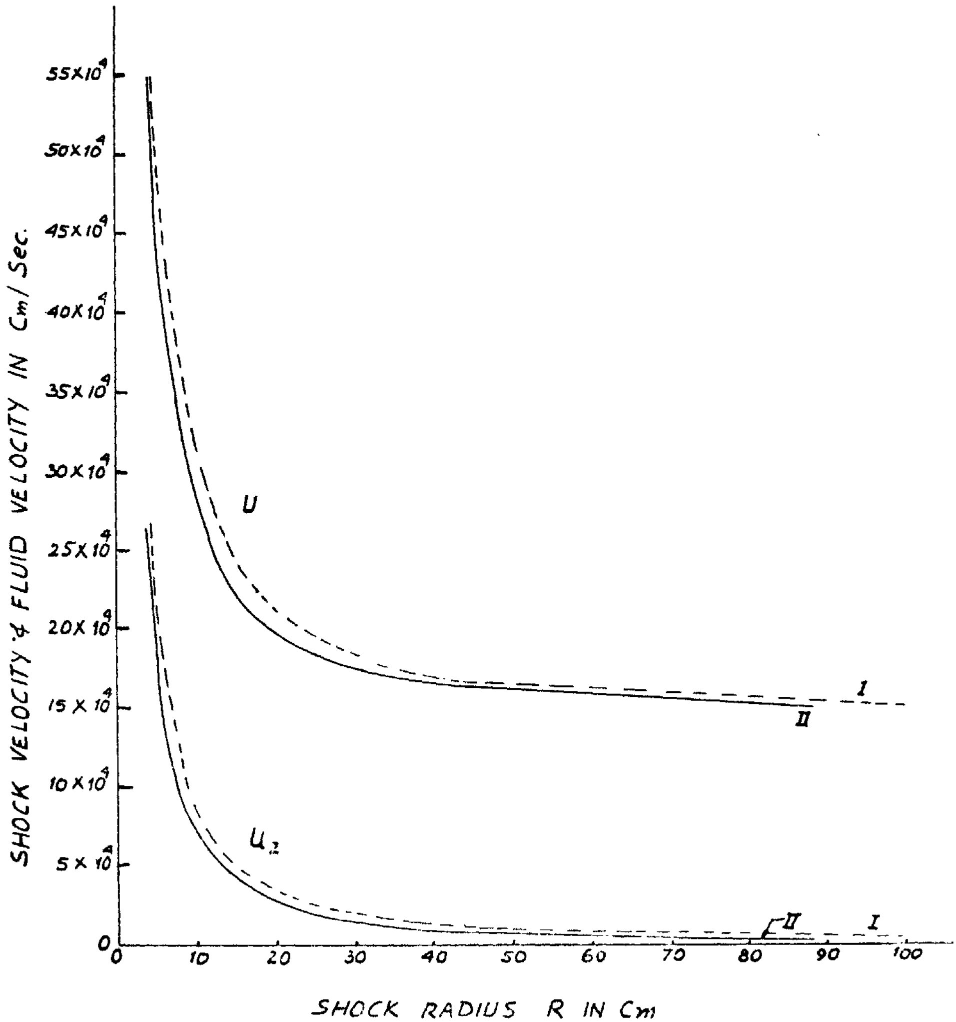

FIG. 2. Variation of shock and particle velocity versus shock radius. Dashed lines are those of paper I.

where symbols have usual meaning (Singh 1974). Here also a is proportionality constant. From (2), we have

$$a = \lim_{R \to a} \frac{4\pi R^3 \rho_2}{3Q} (E_2^* - E_1^*) \qquad (3)$$

If subscript i denotes values of parameters at the interface, i.e. at $R=a$, we have from (3) and relation (9) of paper I,

$$\alpha = \left[p_{1i} + A \left\{ \left(\frac{p_{2i}}{\rho_{1i}} \right)^n - 1 \right\} \right] \left(\frac{\rho_{2i}}{\rho_{1i}} - 1 \right) \frac{4\pi a^3}{3 J Q} \quad \ldots \quad \ldots \quad (4)$$

Where J is the mechanical equivalent of heat. It is seen that α is a dimensionless constant.

Combining equs. (3) and (4) with the jump conditions [eqns. (6)—(9) of paper I] , we get variations of p_2, ρ_2, u_2, U behind the shock.

Conclusion

Here same data is used for numerical computation as that of paper I. Value of α in this case is 1.2218. Pressure and densities jump versus shock radius and velocity versus shock radius have been plotted (Figs. 1 and 2) using the present method and the method of paper I. It is observed that the delay in shock is more in the present method. It is assumed in the present method that the gas bubbles are not present. But it is not the case. The presence of gas bubbles will also decrease the strength of shock. It is our intention to further modify energy hypothesis by taking into account the effect of gas bubbles.

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