THE RELATION BETWEEN BREAKING THE SOUND BARRIER & VAPOR CONES FORMATION

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THE RELATION BETWEEN BREAKING THE SOUND BARRIER & VAPOR CONES FORMATION.

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ABSTRACT

As aircraft accelerates from the subsonic speed to supersonic speed an extraordinary phenomenon occurs, which is called the vapor cone also known as shock collar or shock egg. A vapor cone is visible cloud of condensed water that can form around an object moving at high speed through air. In this paper, we discuss the reason for this phenomenon.

Figure 1 A Hornet breaking sound barrier (7_July_1999)

1. INTRODUCTION

The vapor cones are created by a shockwave generated by an aircraft as it accelerating up speed. The shock waves are the physical effects of the aircraft travelling so fast through air. As the aircraft accelerating up speed, and approaches the speed of sound – 1,234km/h at sea level – shockwaves form around the aircraft. Across these shockwaves there is 'discontinuity' in the local air pressure and temperature. This causes the air to lose its capacity to hold water and condensation starts to form, creating the vapor cone. "If you see a vapor cone, you've got a shockwave, because you've got a change in pressure and temperature," Rod Irvine, the chairman of the Royal Aeronautical Society's aerodynamics group

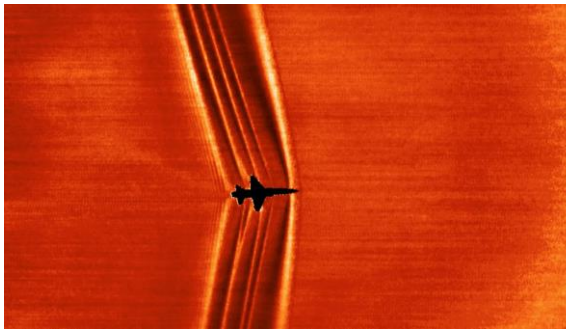

Figure 2 Attached shockwave on a sharp-nosed supersonic body

A shockwave is a type of propagation disturbance that moves faster than the speed of sound in a medium, which is like any other wave carries energy and propagate through a medium but characterized by an abrupt, change in pressure, temperature, and density of the medium.

2. VAPOR CONE FORMATION.

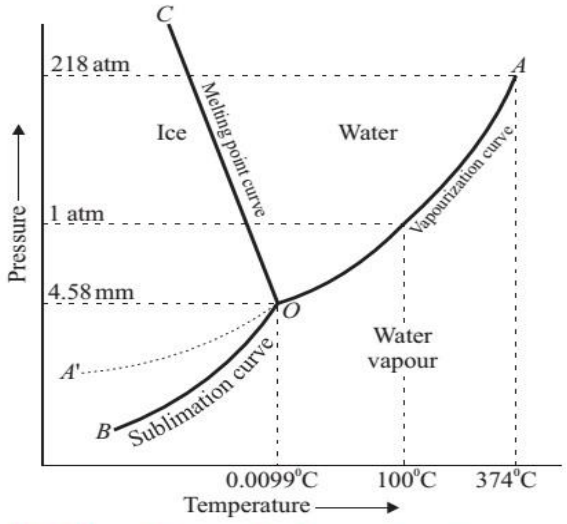

Fig. Phase diagram for the water system

The main reason that observable cloud sometimes forms around any high-speed aircraft is that the humid air is moving from high-pressure region with high-temperature and density to a low-pressure region, which also reduces local density and temperature sufficiently to cause water to supersaturate around the aircraft and to condense in the air, thus creating clouds. The clouds vanish as soon as the pressure increases again to ambient levels.

In the case of objects at transonic speeds, the local pressure increase happens at the shockwave location, which also increases the temperature and density. Given sufficiently high humidity. The air would be condensed at the moment it gets out from the shockwave location to the low pressure, low temperature and low-density medium.

3. CONCLUSION

The Vapor cone is just a condensed air. Air with high-humidity passes from High-pressure, High-temperature and High-density region created by a shockwave to low-pressure, low-temperature and low-density region causes condensation.

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