Heavy Water Encyclopedia Article

Heavy Water

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Contents

Heavy Water Encyclopedia Article.....1

Contents.....2

Heavy Water.....3

Heavy Water

Ordinary water consists of two hydrogen atoms and one **oxygen atom**. Heavy water consists of two deuterium atoms and one oxygen atom. Deuterium is an **isotope** of hydrogen; both have the same number of protons, and therefore have the same atomic number. However, deuterium has one **neutron** in its **nucleus** while hydrogen has none and so deuterium is heavier than hydrogen. Thus a molecule of heavy water has a **mass** of 20 atomic units while an ordinary water molecule has a mass of 18 units. Pure heavy water is 10% more dense than ordinary water; it freezes at 38.8°F (3.8°C) and boils at 214.5°F (101.4°C). It is not radioactive and occurs naturally in nature in limited quantities.

Heavy water, which can be harvested from natural water sources or created from electrolyzed water, is used as a moderator in nuclear **power** plants. The uranium-235 in the reactor can capture neutrons only if they are moving slowly enough; thus a moderator is needed to slow the particles. High-speed neutrons hit the deuterium and lose some of their **momentum**, slowing the neutron. Ironically, slowing down the neutrons will increase the **nuclear fission** rate. Ordinary water is used as a moderator as well, but absorbs most neutrons instead of just slowing them through collisions; these reactors must use enriched uranium to be able to sustain nuclear fission. Other uses for deuterium include quantum effect experiments, extensive use in **molecular structure** studies, superconductivity experiments, chemical **kinetics**, nuclear magnetic resonance shift studies, dipole moment studies, ESR hyperfine interactions, geochemical experiments, and experiments dealing with growth and morphology of plants and animals.