



Contents lists available at ScienceDirect

Fusion Engineering and Design

journal homepage: www.elsevier.com/locate/fusengdes



Development of pellet fuelling system in HL-2A tokamak

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ARTICLE INFO

Article history:

Available online 6 May 2011

Keywords:

Pellet injection
Extrusion technology
HL-2A tokamak

ABSTRACT

For increasing the plasma density and improving the plasma confinement, a new pellet fuelling system based on the extrusion technology has been developed successfully and set up in the low field side of the HL-2A tokamak. It is designed to produce 1–40 solid pellets of hydrogen/deuterium in one injection cycle. The pellet fuelling system consists of six main parts: (1) Vacuum system, which includes two independent sub-systems and can pump the corresponding spaces to 10^{-3} Pa and below 10^{-5} Pa, respectively. (2) A closed-cycle helium cryorefrigerator of 1 W power at 4.2 K, which is used for cooling of the injector and pellet production. (3) A pellet size regulator, which is used for extrusion of ice ribbon with different dimensions. (4) Electromagnetic cutter, which is used to cut the ice ribbon to pellets with high frequency (up to 30 Hz). (5) Gas supply system, it can provide the pellet material of D_2 or H_2 and propellant gas of helium, and (6) control and diagnostic system.

During our 2009–2010 experimental campaign, we made some commissioning tests for the fuelling system and injected the deuterium pellets into the plasma with the typical parameters as follows: pellet size are with the diameter = 1.3 mm and length = 1.3–1.7 mm, number of pellet $N_p = 3–5$, frequency of injection $F_i = 10/20$ Hz, velocity of pellet $V_p = 200–300$ m/s by helium propellant gas with pressure of 0.6–1 MPa. The injection reliability is more than 90%. This paper will describe the new pellet fuelling system in detail, and present some preliminary injection experimental results in HL-2A tokamak.

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