Visualization of Internal Flow and Spray Formation with Real Size Diesel Nozzle

T. Hayashi*[1], M. Suzuki[2], M. Ikemoto[3]
1: NIPPON SOKEN, INC., Nishio, Aichi Japan
2: DENSO CORPORATION, Kariya, Aichi Japan
3: TOYOTA MOTOR CORPORATION, Susono, Shizuoka Japan

Abstract

The internal flow of a diesel nozzle and its spray formation have been investigated by flow visualization with real-size transparent nozzle. The string-type and film-type cavitations are separately observed in the nozzle hole during the injection stage. Through analyzing the frequency of the cavitation generation and spray fluctuation, it is evident that with the increase of string-type cavitation, spray cone angle tends to be wide.

Introduction

Recently, many studies have focused on the internal flow in the injector nozzle and its spray formation. They indicate that the spray characteristics are markedly influenced by cavitation generated in the nozzle hole. This study established the flow visualization method in the real-size nozzle and investigated the relationship between the transient nozzle internal flow, cavitation, and spray formation. A mini-sac (MS) nozzle and valve-covered orifice (VCO) nozzle were surveyed to analyze the influence of the nozzle design toward the internal flow and spray characteristics.

Transparent nozzle

The tip of an actual injector nozzle was modified to provide optical access. The transparent nozzle is made of acrylic resin, which possesses a refractive index that is similar to that of the diesel fuel (Figure 1). In order to evaluate the internal flow and cavitation generated in the actual nozzle, the geometry of the sac and hole of the transparent portion were made to be the same as the original nozzle.

Results and Discussion

The string-type and film-type cavitations are separately observed in the nozzle hole. String-type and film-type cavitations both generated in the MS nozzle hole (Figure 2-a). Regarding the VCO nozzle, film-type cavitation on the nozzle hole inlet plays a more dominant role rather than the string-type cavitation, and the spray cone angle is narrower than that of the MS nozzle (Figure 2-b).

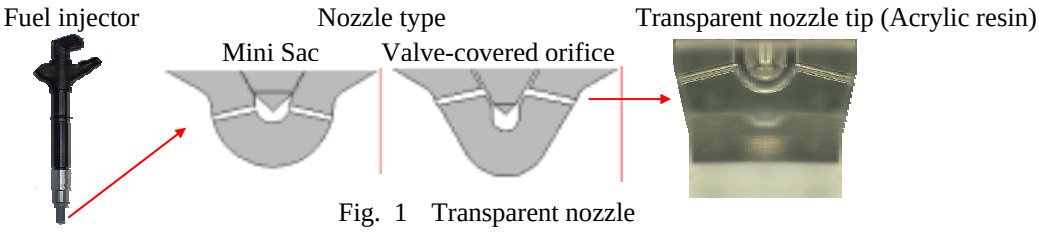
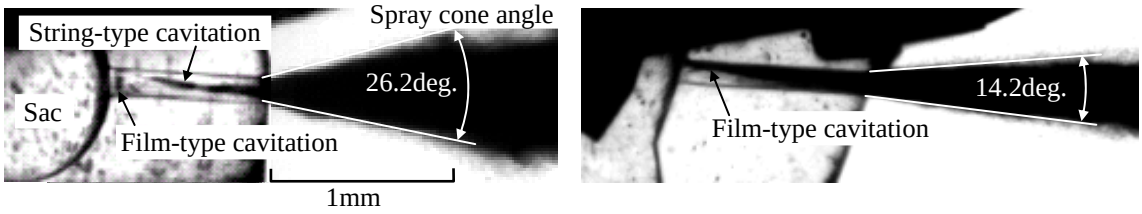


Fig. 1 Transparent nozzle



(a) 3-hole MS nozzle (b) 3-hole VCO nozzle

Fig. 2 Transient characteristics of cavitation and spray close to the nozzle hole outlet
(T_a=293K, P_a=1MPa, P_{inj}=50MPa, t_{inj}=1.0ms, 0.88ms ASOI)

* TOMOHIRO_HAYASHI@soken1.denso.co.jp