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# A Study on the Geometrical Parameter of a Mixing Chamber in an Air-Induction Nozzle

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## Extended Abstract

For designing nozzles, spray drift is an important consideration. The spread of many pesticides throughout the environment is possible because of spray drift, which results in health hazards. Researchers have taken various methodologies and approaches for controlling the drift potential and improving the efficiency of crop protection products. Air induction (AI) nozzles have gained a great deal of interest as one of the investigated designs [1–3]. AI nozzles can decrease the drift potential so that an improved control would be possible [4]. However, less attention has been paid to AI nozzles than conventional nozzles, and hence the related flow structure, like the droplet size, ALR, and spray angle, has remained unknown. For controlling AI nozzles function, several parameters can be taken into consideration. Between these parameters, fewer studies have been conducted on the geometrical ones, such as the mixing chamber size and divergence angle, even though this parameter has a significant impact on the flow structure within the nozzle [5]. In an AI nozzle, the air-to-liquid ratio (ALR) is also a critical factor that considerably influences spray features.

The objective of the present study is to define the influence of the mixing chamber size and divergence angle on the structure of the two-phase flow inside the AI nozzle and ALR. Moreover, this study attempts to understand the variations of two-phase mixing flow features with the change of the divergence angle and the mixing chamber size.

The nozzle considered for the current investigation consists of six separate sections: the body, the mixing chamber, the jet pump, the pre-orifice, and the nozzle tip. The numerical simulations were conducted to study the unsteady behavior of the flow in an AI nozzle. The two-phase mixture model and the k-ε RNG turbulence model are applied to conduct the simulations. The experimental investigation has also been carried out to validate the results from the numerical study. In the experiments, pure water was used as the working fluid, pressurized with nitrogen in a pressurized tank. A Kulite ETM-375-500A pressure transducer was used for controlling the pressure. A pressure regulator was utilized for regulating the flow rate, and the discharged liquid was manually collected and measured. The validation was conducted for parameters including the ALR and the spray angle, and good agreement was observed between numerical outputs and experiments.

In the next step, numerical simulations were performed considering 16 designed cases with various geometrical parameters to define the influences of the geometrical factors on the flow structure within the nozzle. Based on the results of the present work, the mixing chamber size and the divergence angle affect the ALR rate. With increasing the length of the mixing chamber, the optimum divergence angle was raised. Moreover, the divergence angle influenced the amount and position of the pressure recovery. With the increase of the mixing chamber length, the air amount inside the mixing chamber reduced. In addition, the mixing process was improved in a small mixing chamber, and the portion of the air in the droplets increased. Following the decrease of the mixing chamber size, the diameter of the vortices reduced, becoming gradually unstable. On the other hand, more stable and larger vortices formed in a bigger mixing chamber. Based on the visualization, in the case of a shorter mixing chamber, it was more probable that the flow would be bubbly, and consequently, the air volume fraction increased close to the nozzle tip.

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