Injection-molded, consumable, non-contact dispensing valve applicable for 96-well plate processing

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Abstract

We present a cost-effective, consumable dispensing valve for non-contact and cross-contamination-free applications, fabricated by an injection molding process

- Outer diameter of 8.5 mm (incl. solenoid)
- Silent processing of MWP in 96-well format possible
- CV between 0.1% and 3.7% for all tested prototypes
- No cleaning necessary
- Competes with commercially available, non-disposable dispensing valves (typically CV ≤ 5%)

Working principle

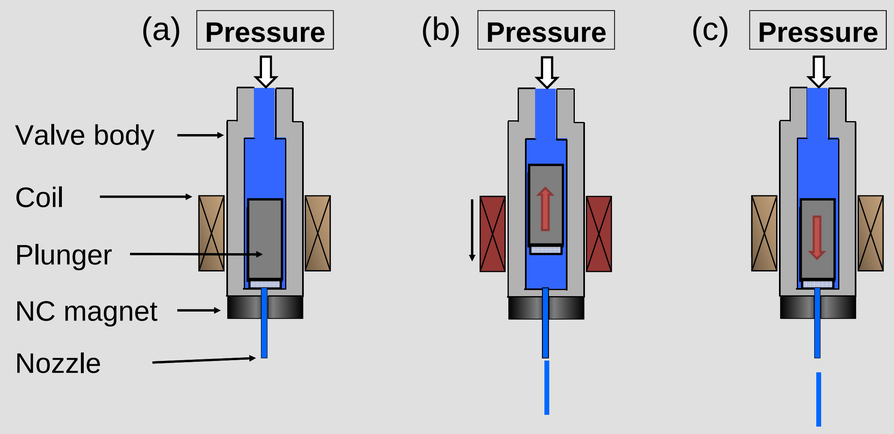
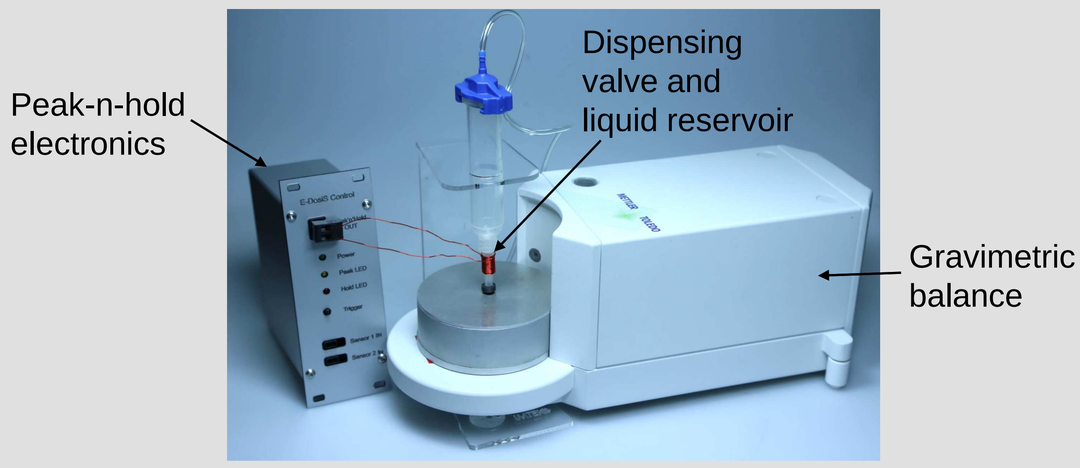


Figure 1: *The movement of the plunger is controlled by the coil current. Working principle: (a) the plunger is in a normally-closed (NC) state due to the attractive force exerted by the NC magnet. (b) a positive current pulse is applied generating a magnetic field. The plunger moves up and opens the valve. (c) after the desired actuation time the current is turned of and the plunger closes the valve by magnetic attraction of the NC magnet. [1]*

Measurement set-up

The dispensing valve is actuated by a specific peak-n-hold electronics [2] and characterized by the GRM method [3].



Experimental Results

The affect of different actuating pressures on the dispensing performance is shown on the right.
Here, the valve shows a highly precise performance with CVs below 1.6% from 230 nL to 5.2 µL.
Higher volumes entail improved performance.

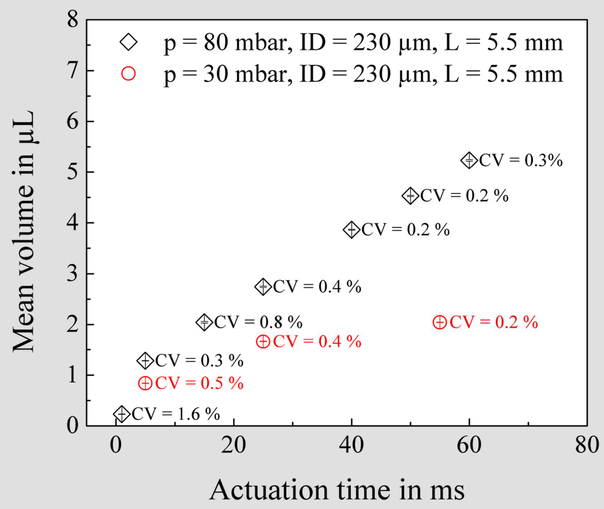


Figure 4: *A data point corresponds to a mean value consisting of 24 dispenses. The corresponding coefficients of variation (CV) is the standard deviation of 24 dispensation divided by the mean value.*

Fabrication by injection molding

A miniaturization study was accomplished in order to make the valve capable for 96-well plate format [2] and the injection-molding process. The result is shown in figure 2.

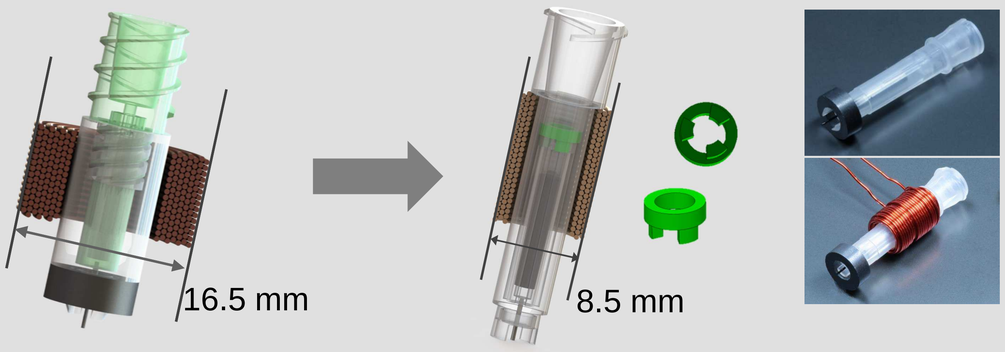


Figure 2: *Left: Initial 2-part design of functional model with an overall diameter of 16.5 mm, fabricated by 3D printing [1]. Right: Miniaturized, injection-molded valve.*

The upper part of the Luer-Lock thread was defined as an optimal gaiting point to guarantee a uniform filling.

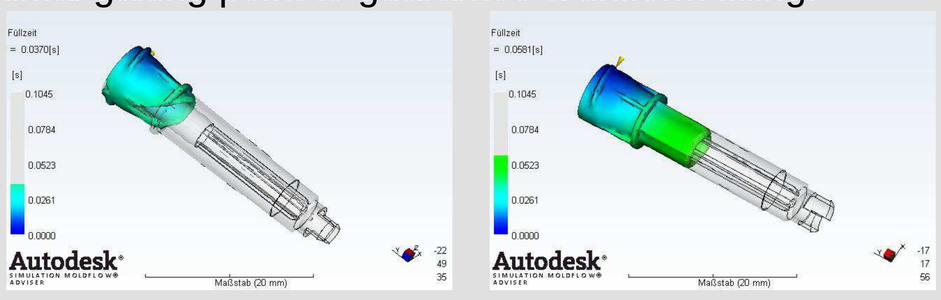


Figure 3: *Mold flow analysis performed by Braunform of the injection molding process for Poly-Propylene (PP) as used material.*

Conclusion

Dispensing valve applicable for liquid handling systems:

- ✓ High precision (CV < 4 %)
  - ➢Competes with standard non-disposable products
- ✓ Non-contact dispensing technology
  - ➢No cross-contamination
- ✓ Low-cost components
  - ➢No expensive cleaning steps
- ✓ High-throughput
  - ➢Compatible to 96-well plate applications

Acknowledgements

We gratefully acknowledge financial support from the German Federal Ministry of Education and Research (BMBF, contract number 16ES0058).

References

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Funding from

Bundesministerium für Bildung und Forschung

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