SMART LINE INJECTION TO CONTROL FLOW IN VARTM

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MOTIVATION AND OBJECTIVE

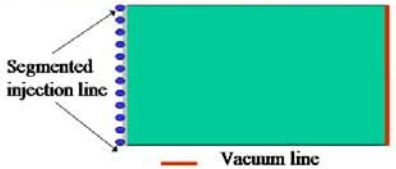
Current methods used for VARTM provide very limited controllability of the resin flow with in the mold which result in the formation of dry spots and voids. Improved control of resin flow appears possible with several approaches like:

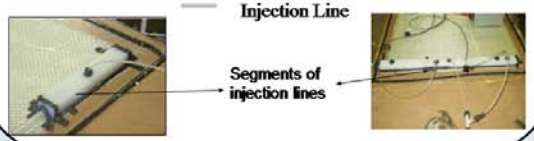
1) Developing a controllable resin injection line.
2) Control of effective permeability of distribution medium and preform.
3) Real time modifications to the flow front.

The objective of this project is to develop a smart resin injection line that provides real time control of the resin flow to obtain better flow control in VARTM and minimize the dry spots and voids.

SMART INJECTION LINE

A smart injection line has:
Controllable segments on the injection line that can be actuated with a computer or a suitable actuation method thus controlling the resin flow to a particular region of the mold eliminating the formation of dry spots and voids in VARTM.





GENERAL APPROACH

Development of actuation method for flow control.

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Simulation of different smart injection line configurations for various mold geometries

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Determination of relationship between line segment configuration and controllable mold region

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Fabrication and bench testing of a smart injection line with multiple segments

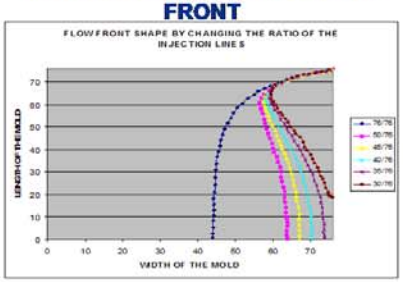
DETERMINATION OF BEST SMART LINE CONFIGURATION

The smart line configuration is based on simulations used to understand the relationship between the segment size and the resulting controllable region with in the mold.

Independent parameters:
1) Number of segments of injection lines.
2) Length of the individual segments.
3) Control action distance.
4) Local and bulk permeabilities.

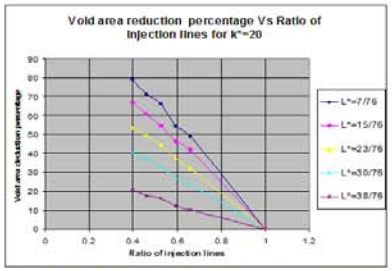
Dependent parameters:
1) Fill time.
2) Void area.

SIMULATIONS - EFFECT OF INJECTION LINE ON THE FLOW FRONT



Race tracking factor of 20 along the top edge of the mold is considered and control action is taken at a distance of L/10 from the injection line.

VOID AREA REDUCTION USING SMART LINE INJECTION



A void area reduction of 80% was achieved by using the smart line injection and controlling the injection line.

CONCLUSIONS

1. There is a considerable decrease in the void area by changing the lengths of the injection line segments and using the suitable control action.
2. Flow front controllability can be achieved and flow can be directed to all parts of the mold using the smart line injection configuration.

FUTURE WORK

introducing more complex features in the mold and then controlling the flow front using the smart line segments.

ACKNOWLEDGEMENTS

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