



CANNING BOTTLING

WILD GOOSE

FILLING



FILLING WITH FINESSE

A practical exploration of filling: theory, methods, current technologies, popular mechanisms, and equipment design implications.



OVERVIEW

Topics covered:

- Intro
- Some of the science
- Pre-filler factors
- Definitions
- Different fill methodologies

Topics NOT covered:

- DO/O₂ pickup
 - Politics
 - COVID
 - Religion
- and honestly, pretty much everything else.



INTRODUCTION – WHO AM I?

- Alexis Foreman
- Co-founder Wild Goose Canning
- BS Chemistry
- Professional experience :Pharma and Biotech QC/R&D, Extensive Engineering and machine design
- Designing, Developing, Implementing, and troubleshooting filling systems for 10 years.

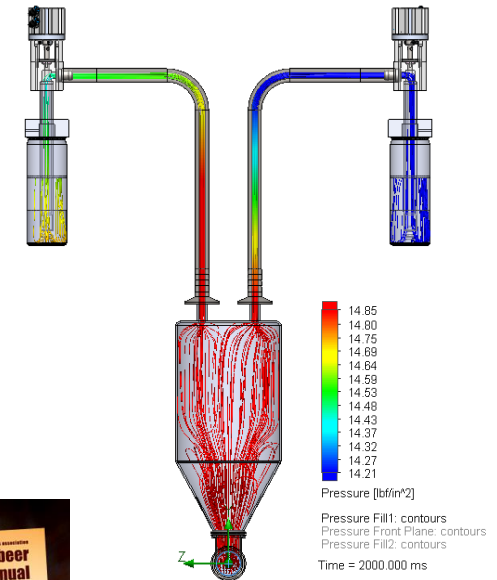


WHY ARE WE HERE?

“If you wish to ~~make an apple pie from scratch~~ (package amazing beverages), you must first invent the universe.”

- Carl Sagan

- Pouring carbonated beverages is far from simple.
- As if fluid mechanics is not complicated enough, we get to factor in chemistry and thermodynamics.
- Don't worry though- it's just the quality of your finished product hanging in the mix





PROPER FILL TAKES PROPER UNDERSTANDING

Pre-Filler factors

- Product condition
- Temperature
- Starting/vessel pressure
- Transfer Distance
- Line restriction/elevation
- Product inlet integrity

Filler factors

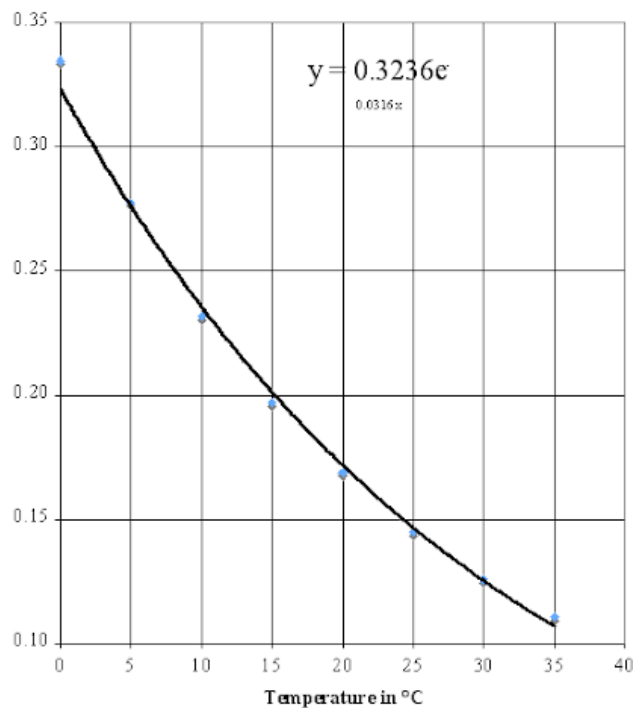
- Filler system anatomy
- Different fill methodology
- Fill volume detection
- What they mean and when it matters



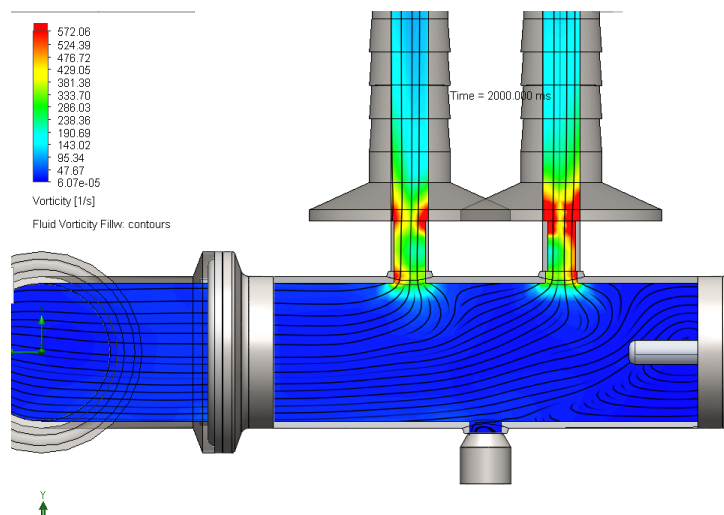
CHEMISTRY OF CARBONATION

CO2 solubility and temperature

Solubility of Carbon Dioxide in Water

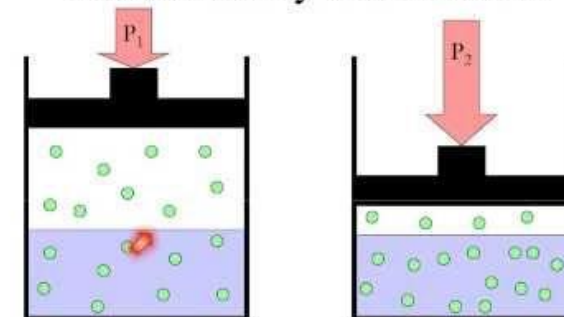


Temperature and pressure are the key factors. Temperature is obvious- Pressure is far more dynamic.



CO2 solubility and pressure

Gas Solubility and Pressure

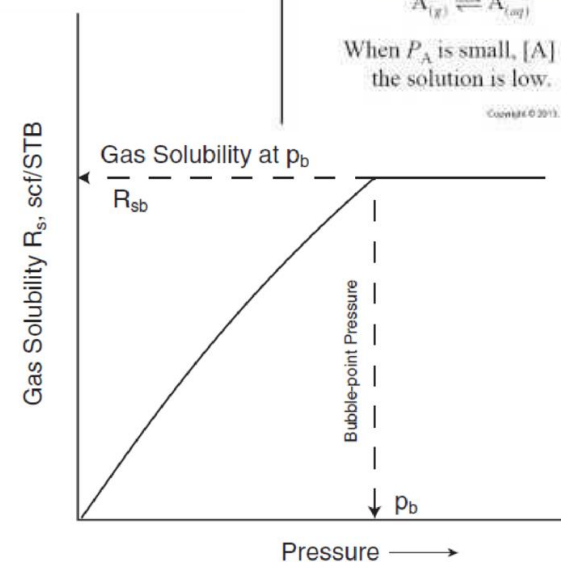


When P_A is small, $[A]$ in the solution is low.



When P_A is large, $[A]$ in the solution is high.

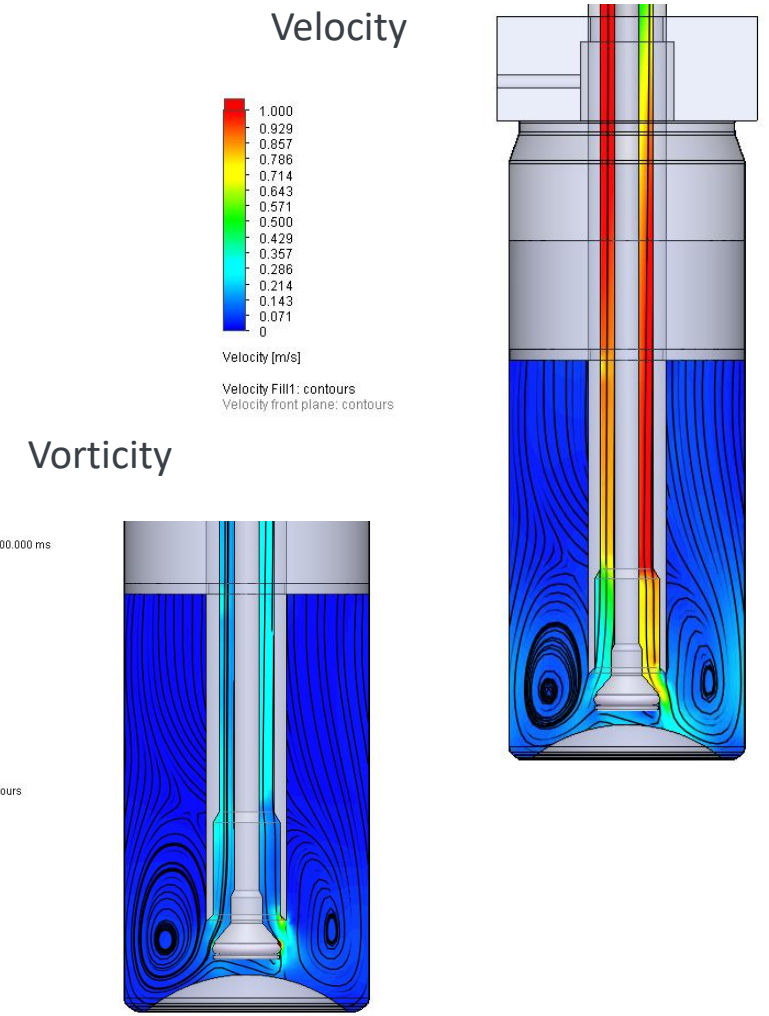
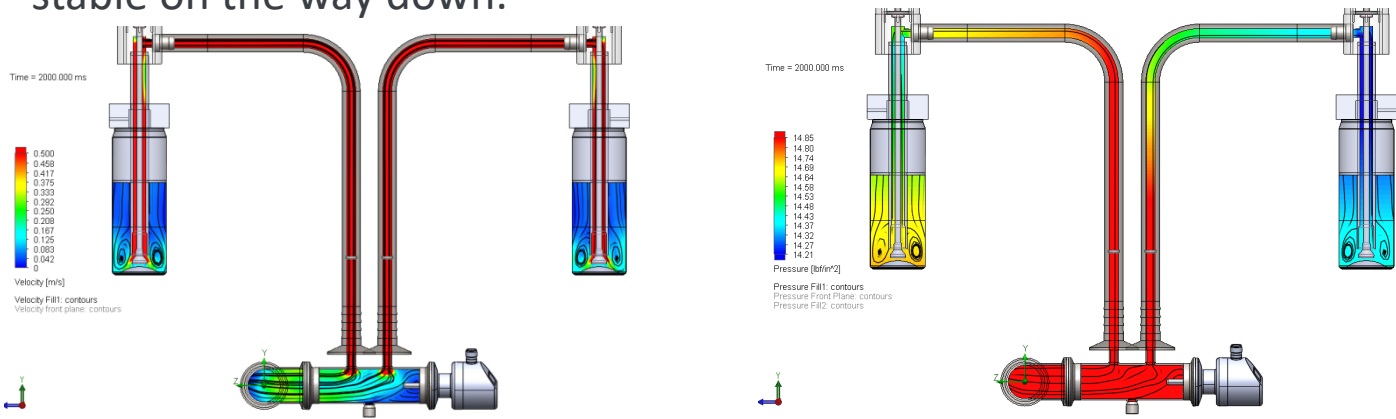
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IMPORTANCE OF PRESSURE

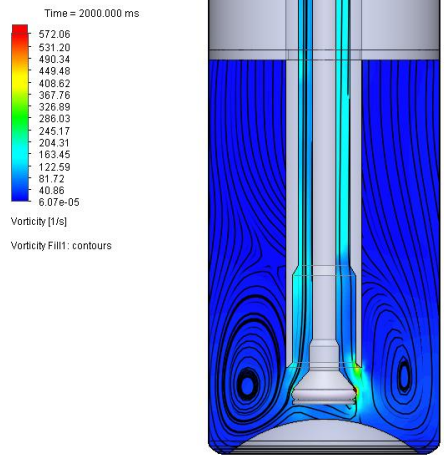
- Desired carbonation level and temperature dictate necessary tank head/product pressure.
- Controlling pressure drop throughout the process is the key to CO2 retention.
- Velocity creates turbulence (Vorticity).
- Vorticity creates pressure instability.
- Sudden transitions in pressure create breakout/loss of CO2.
- Key to carb retention and non-foaming/accurate fill is management of pressure through the process.
- Every filler method has to go from tank pressure to atmospheric pressure- the difference lies in how quickly it can be done and keeping the product stable on the way down.



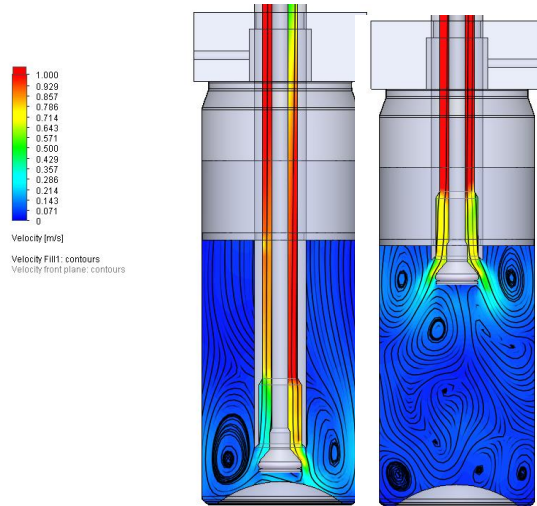


VORTICITY, VELOCITY, AND PRESSURE

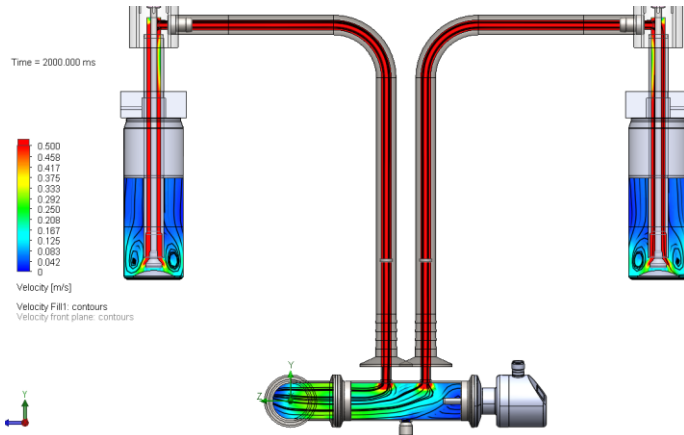
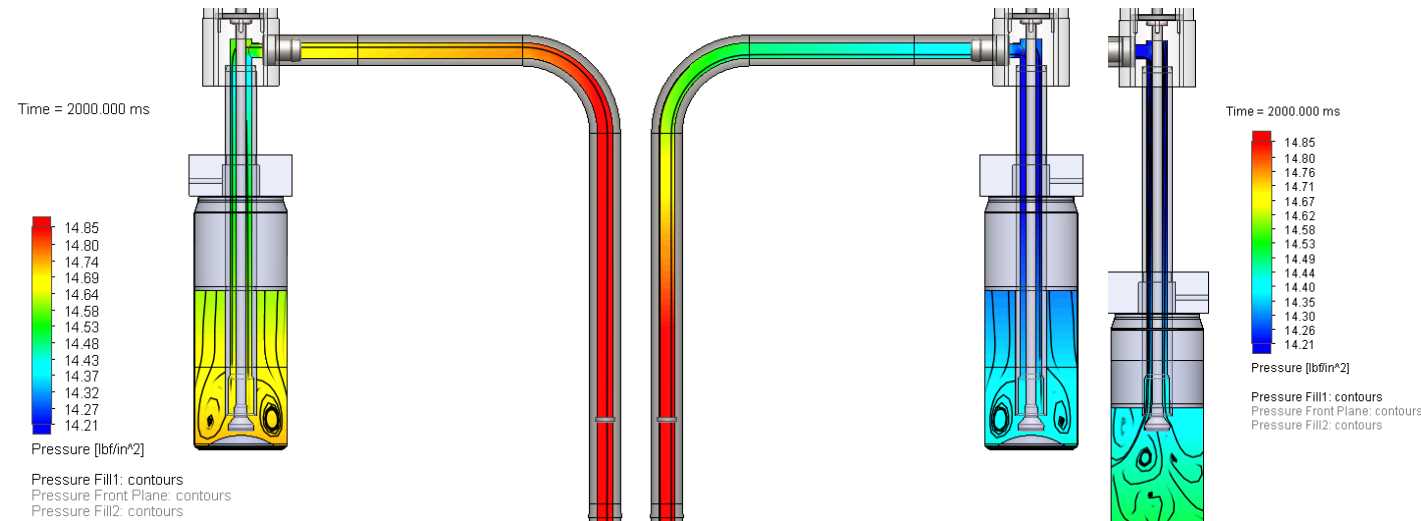
Vorticity



Velocity



Pressure





DEFINITIONS- FILL METHODS

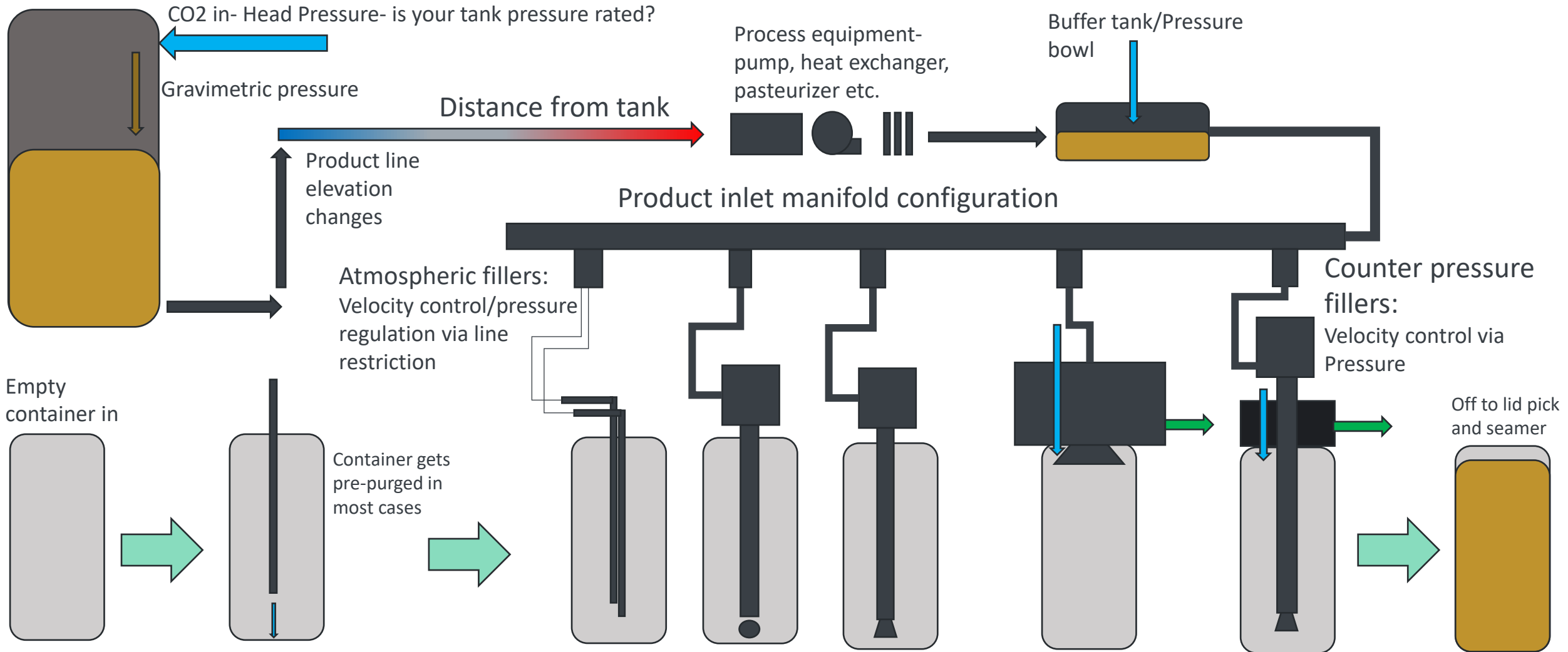
Gravity: Transfer of liquid from an elevated vessel into a container using the force of gravity. Uses include still liquids water, solvents, paint, etc.

Atmospheric: Transfer of liquid from a pressurized vessel into a container that is open to atmosphere.

Counter Pressure: Transfer of liquid from a pressurized vessel into a container that is pressurized.



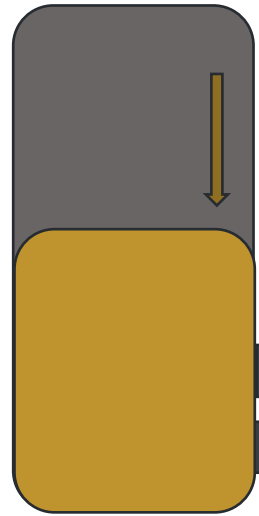
ANATOMY OF FILLING-THE JOURNEY FROM TANK TO PACKAGE





SMALL DIAMETER LINE RESTRICTION

Small diameter product lines of set length dictate pressure drop, much like a draft system.

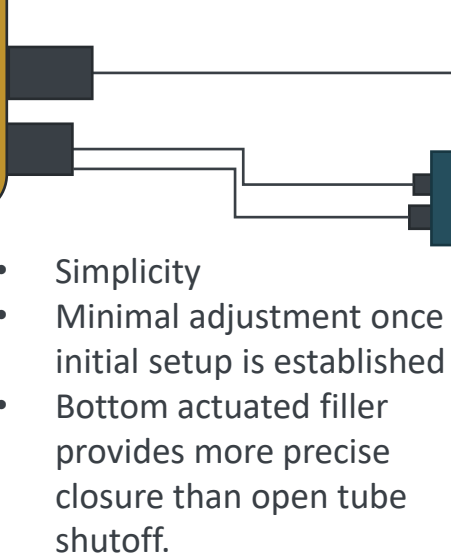


Advantages

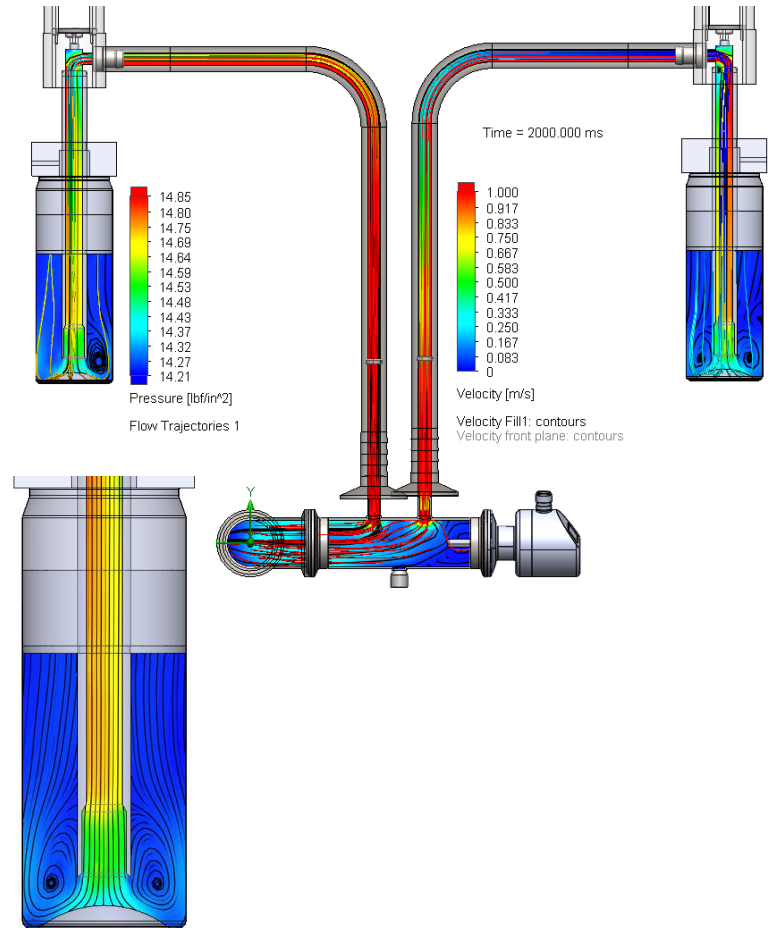
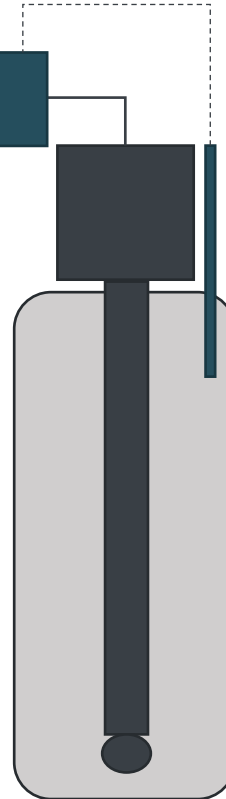
- Simplicity
- Minimal adjustment once initial setup is established
- Bottom actuated filler provides more precise closure than open tube shutoff.

Disadvantages

- Minimal Adjustment
- Slower speed (CPM/fill head)

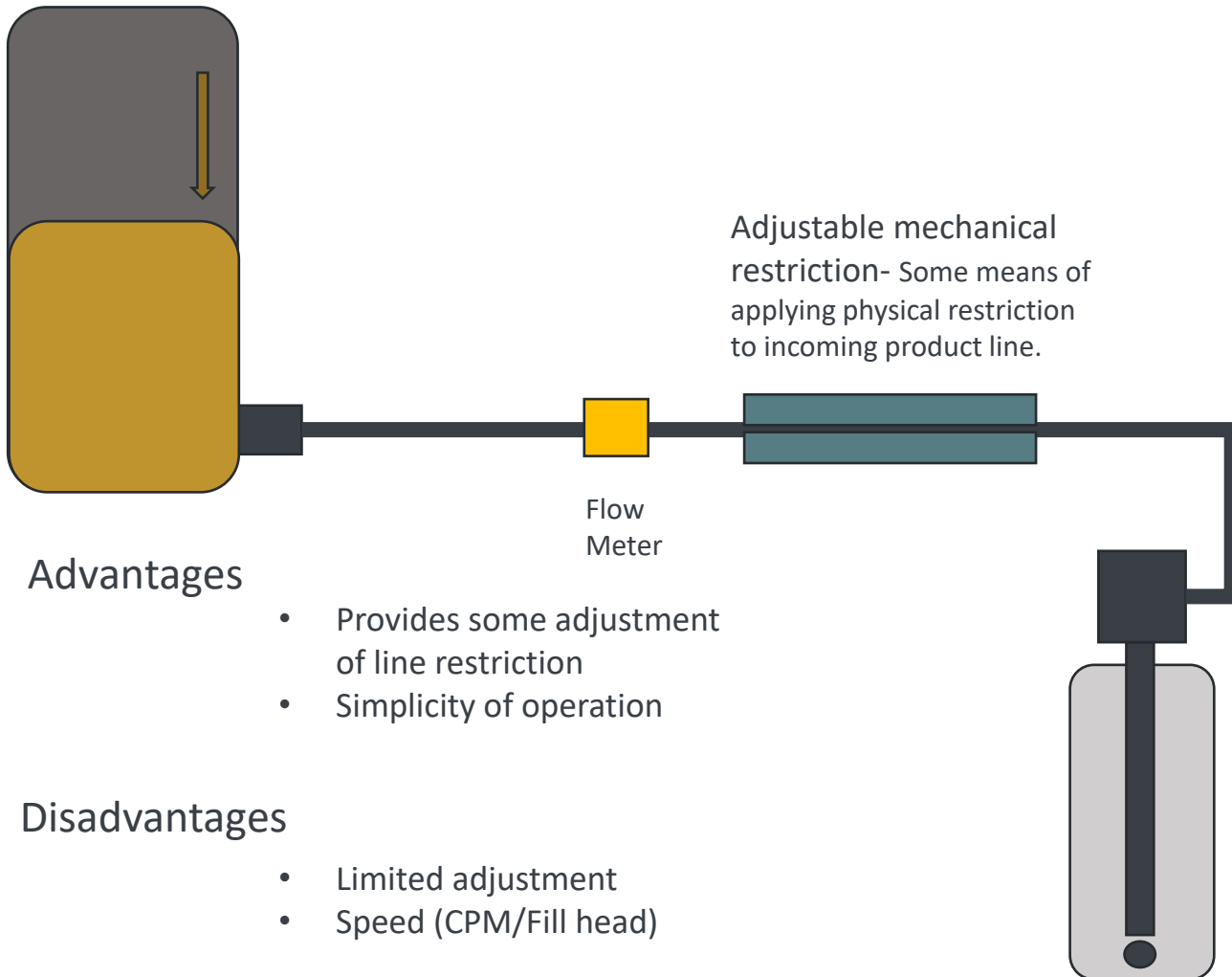


Conductive level sensor dictates fill level

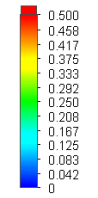




ADJUSTABLE LINE RESTRICTION

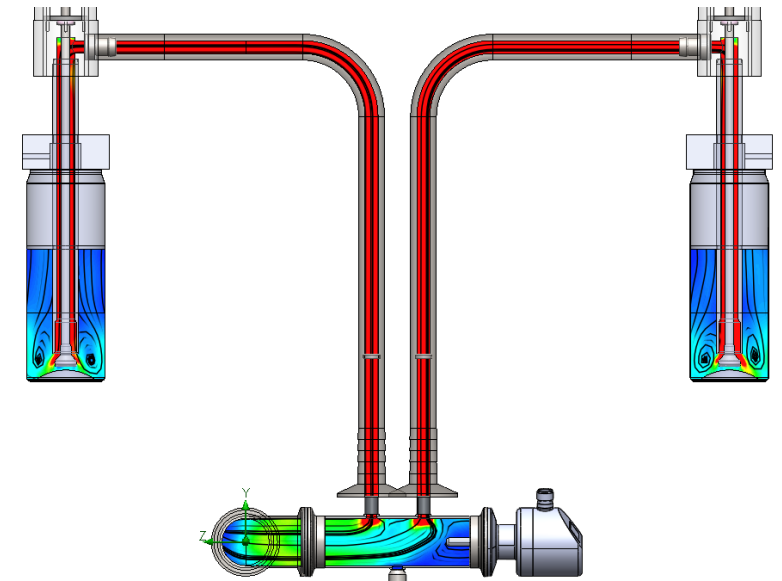


Time = 2000.000 ms



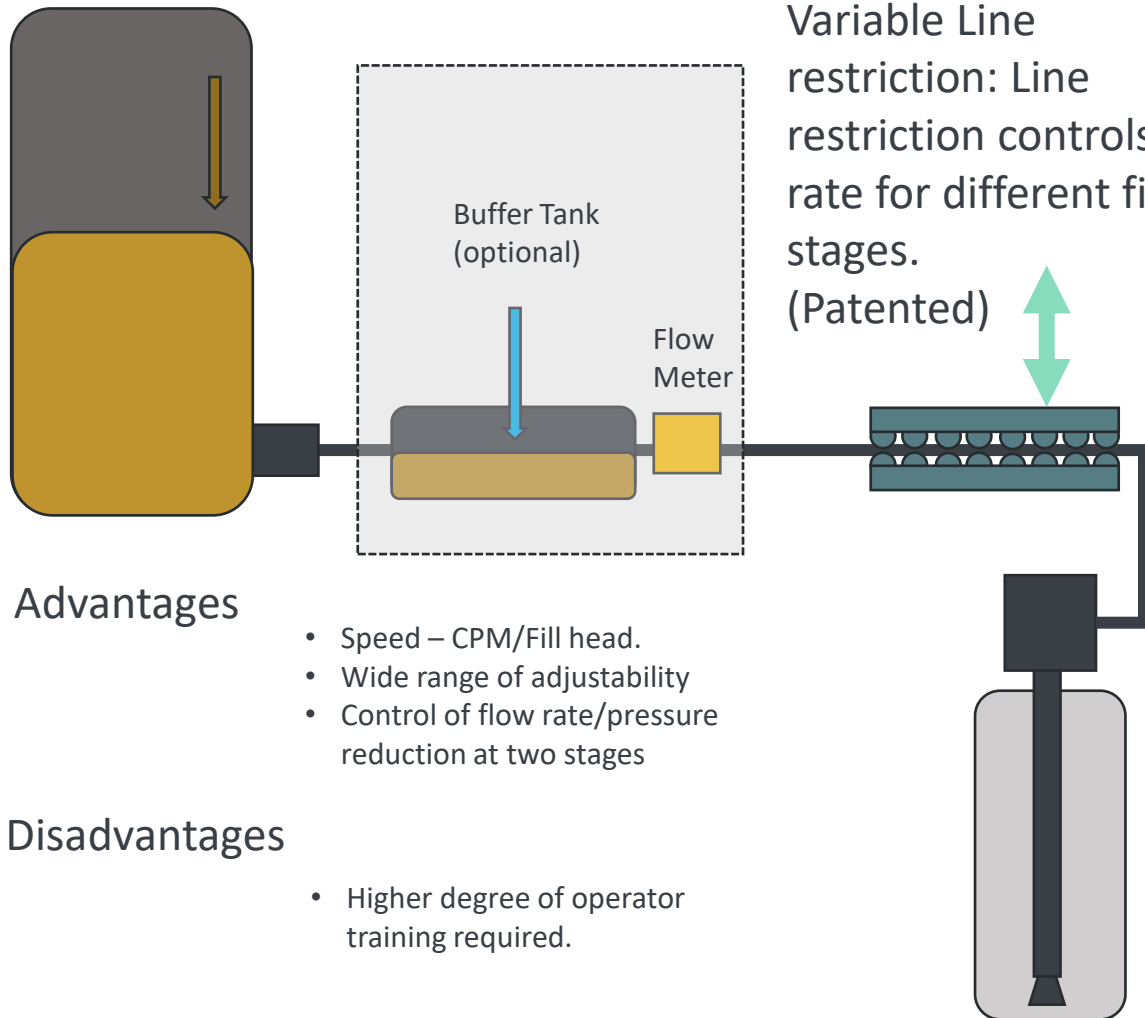
Velocity [m/s]

Velocity Fill1: contours
Velocity front plane: contours





VARIABLE LINE RESTRICTION

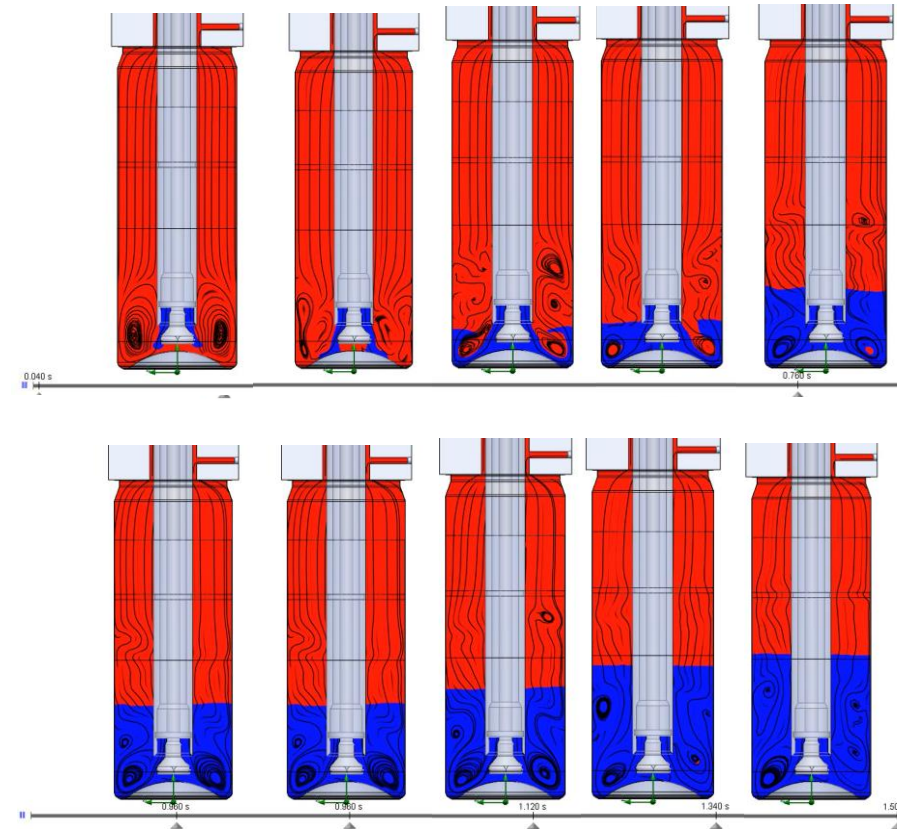
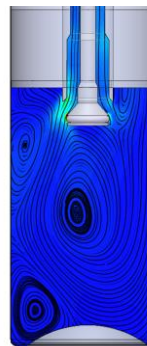
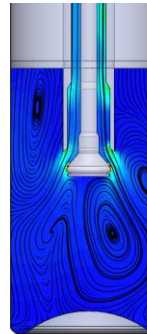
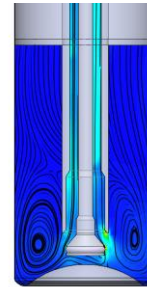
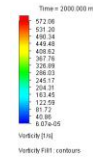


Advantages

- Speed – CPM/Fill head.
- Wide range of adjustability
- Control of flow rate/pressure reduction at two stages

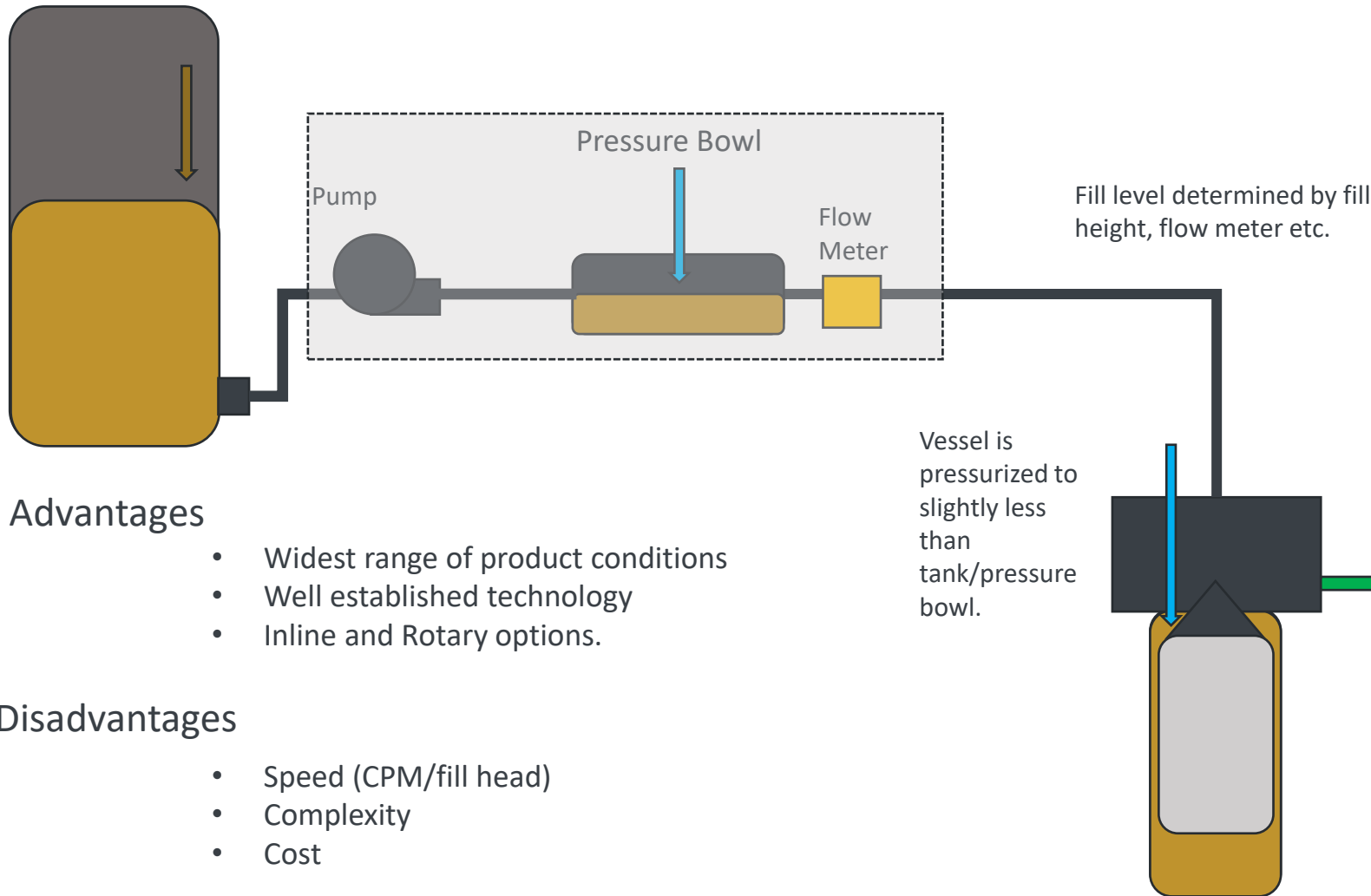
Disadvantages

- Higher degree of operator training required.





TOP FILL COUNTER PRESSURE



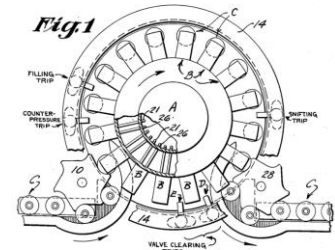
Advantages

- Widest range of product conditions
- Well established technology
- Inline and Rotary options.

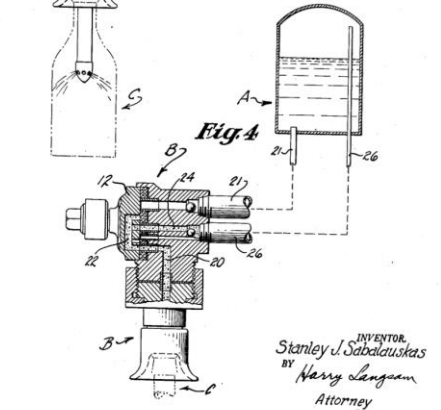
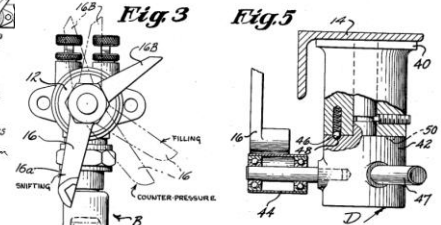
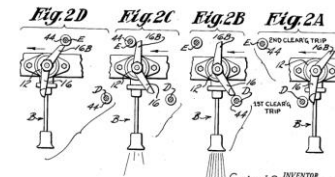
Disadvantages

- Speed (CPM/fill head)
- Complexity
- Cost

Oct. 12, 1954 S. J. SABALAUŠKAS 2,691,477
 Filed Oct. 14, 1949 FOAM PREVENTION APPARATUS FOR CARBONATED BEVERAGE BOTTLING MACHINES 2 Sheets-Sheet 1



Oct. 12, 1954 S. J. SABALAUŠKAS 2,691,477
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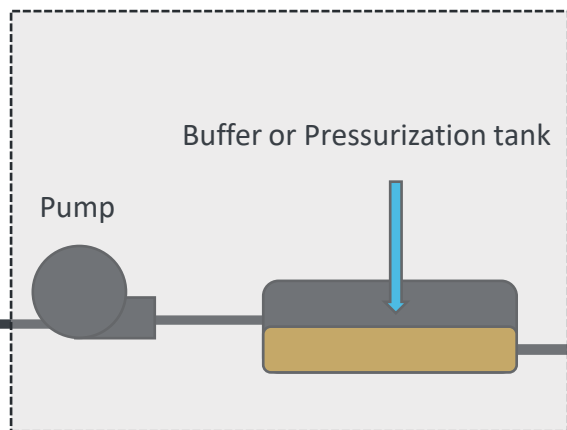
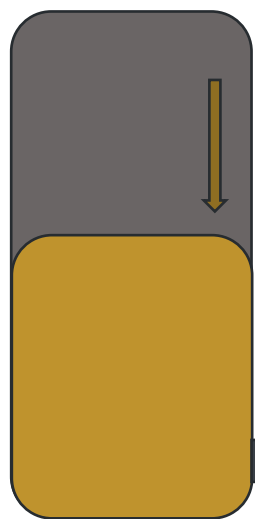


INVENTOR
 Stanley J. Sabalauškas
 BY Harry Longman
 Attorney

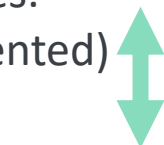


SUB SURFACE COUNTERPRESSURE

(PATENTS PENDING)



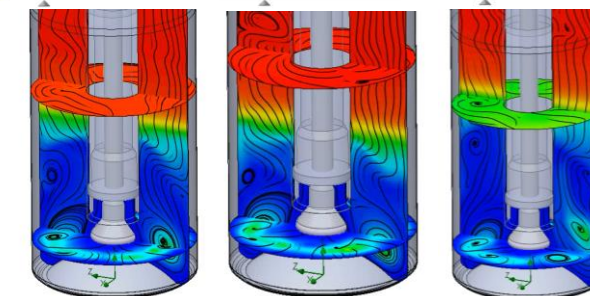
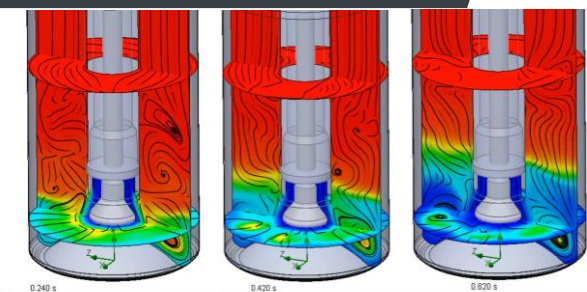
Variable Line restriction: Line restriction controls flow rate for different fill stages. (Patented)



Flow Meter



Fill head raises to maintain optimal sub surface fill, while seal head maintains vessel pressure.

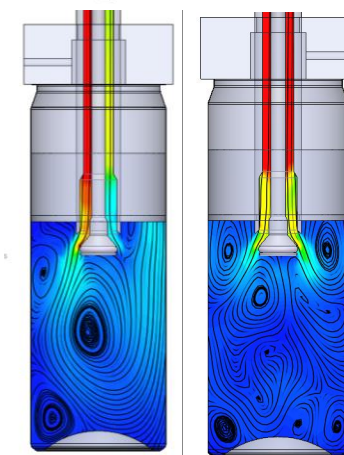
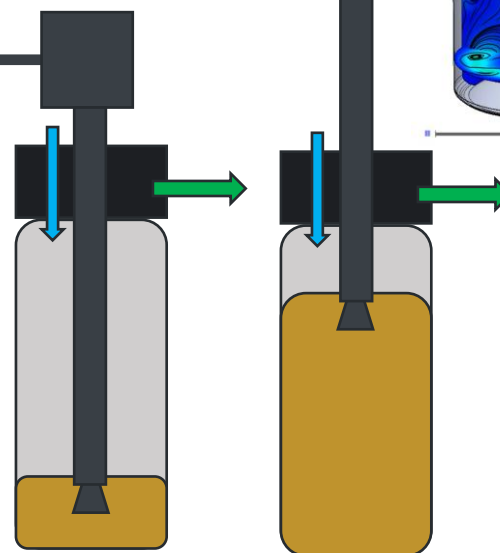


Advantages

- Combines advantages and speed of variable line restriction methods with added bandwidth of counter pressure methods.
- Counter Pressure when you need it, Atmospheric when you don't.

Disadvantages

- Available 1/21- Coming soon!





QUESTIONS

