RECALL OF COMMENTS FROM FLOOR REGARDING IRRADIATED ^{18}O WATER TRANSFER, COMBINING WHAT WAS SAID ON TWO OCCASIONS WITH WHAT SHOULD HAVE BEEN SAID

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At Duke, transfer from target to hot lab of irradiated O-18 water containing F-18 ion as originally installed proceeded as follows: the target is vented, an exit valve is opened and the load of 300 μL of water is allowed to "fall" out of the target into a dependent loop of the delivery line. Then, with the vent still open, several pulses of pressure (3 psi nitrogen for 0.1 second, every 10 seconds) are applied to the target, emptying it of any remaining water. The vent is then closed, and the pulses of pressure (to reduce average pressure) are used to start the water on its journey. As the water reaches the hot lab, a constant 3 psi is applied. The delivery line was 0.035" ID polyethylene (PE). After the dependent loop, the water encounters a 7-foot (almost) vertical rise, followed by a level or down-hill course to the hot lab, 67' (tubing length).

This system delivered target water, despite lack of cleaning except for blowing with dry nitrogen, for about 80-90 runs without any serious problems. Then deliveries became erratic, protracted and broken. It was observed that severe breakup of the bolus would withstand application of 14 psi without moving the water.

Cleaning the tubing with reagent alcohol restored delivery to some extent, but only for a few runs. Finally, delivery could not be accomplished with any pressure at the time. The tubing was replaced with another, supposedly 0.035" ID PE, which made only a few deliveries before failing to deliver at all.

It was discovered that the second tubing had an ID of only 0.31", making the bolus about 25% longer, with 25% less frontal area. Even 5 psi would not move water against the increased friction with diminished pushing area. Sudden application of higher pressures would fracture the bolus, obviating delivery. Another of the original 0.035" tubings was found in another branch of the line and placed in service, but it failed because of severe metal ion contamination of the O-18 water (see report of FDG production).

Several PE and teflon lines with internal diameters up to 0.045" were then tried, with a more gentle, longer rise of 7 feet. It was observed that, while climbing the rise under pulsed pressure, the bolus would slide back and forth, dropping off trailing droplets with each pass. Additional experimentation indicated that the 7' vertical rise would continue to cause problems regardless of delivery line type and size.

A new bundle of PE and teflon (3 each) tubings with identical inside diameters (0.035", 0.042" and 0.045") was mounted so that, after a horizontal loop to hold the bolus after it drained from the target, ramped upward gently travelling about 8 feet to rise 2-1/2 feet. It then proceeded for about 82 feet (additional) at 7 feet above the floor, along the cyclotron entrance vault maze, and entered the hot lab. The tubings are in an open channel for easy replacement.

Deliveries with the new system became at once easier and more reliable. Operation was started with the 0.035" ID PE, with ethanol cleaning once per week. After about 20 runs, delivery became more difficult and after about 10 more this line was abandoned in favor of a PE line 0.042" ID. However, it was quite evident that the more gentle, smaller rise offered a great improvement in performance. Cleaning was deliberately withheld from time to time to test its effect. The larger line eventually showed increasing delivery delay, and after about 50 runs, was replaced by a teflon line, 0.042" ID, which is still in service at this time. Nitrogen supply pressure is currently set at 3 psi.

CONCLUSIONS

1 A horizontal "receiver loop" in the line immediately out of the target helps to hold the bolus of water together.
2. Tubing internal diameters of less than 0.035" greatly increase difficulty of delivery.
3. A steep vertical rise of over 3 feet should be avoided if possible. Vertical lift distances should be limited to the minimum possible.
4. If an increase in elevation is unavoidable, gentle ramping is preferable, even if it greatly increases the length of the delivery line. Horizontal distance does not seem to be critical if bolus velocity is kept low with minimum pressure.
5. The least pressure that will move the bolus should be used. Excessive pressures tend to fracture the water bolus, after which the line becomes "stiff", requiring great pressure to move the water.
6. Short, infrequent pulses of low pressure move a water bolus with minimum tendency to fracture the bolus.
7. Teflon allows delivery as rapid as that afforded by PE, but is more troubled by drop-off of trailing droplets.
8. The last drop of water to exit the delivery line will explode laterally as well as forward. Minimizing the push pressure reduces the violence of the explosion.
9. Delivery lines have limited life even if cleaned regularly; expect to change them every few weeks.