CO2 Scrubber Instrumentation

GAS DETECTION SOLUTIONS FOR HOSTILE ENVIRONMENTS

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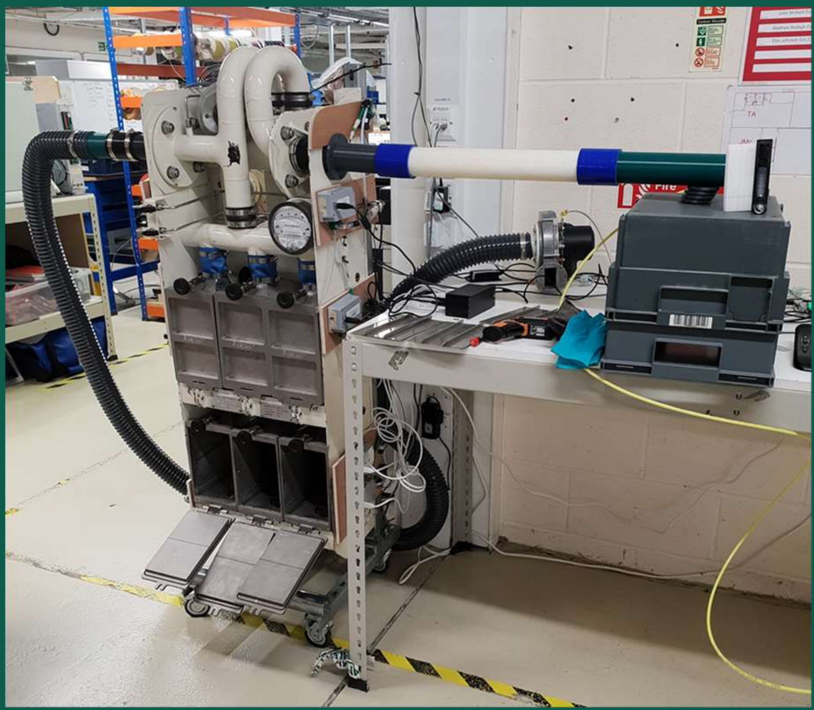
Introduction



Experimental setup of the system

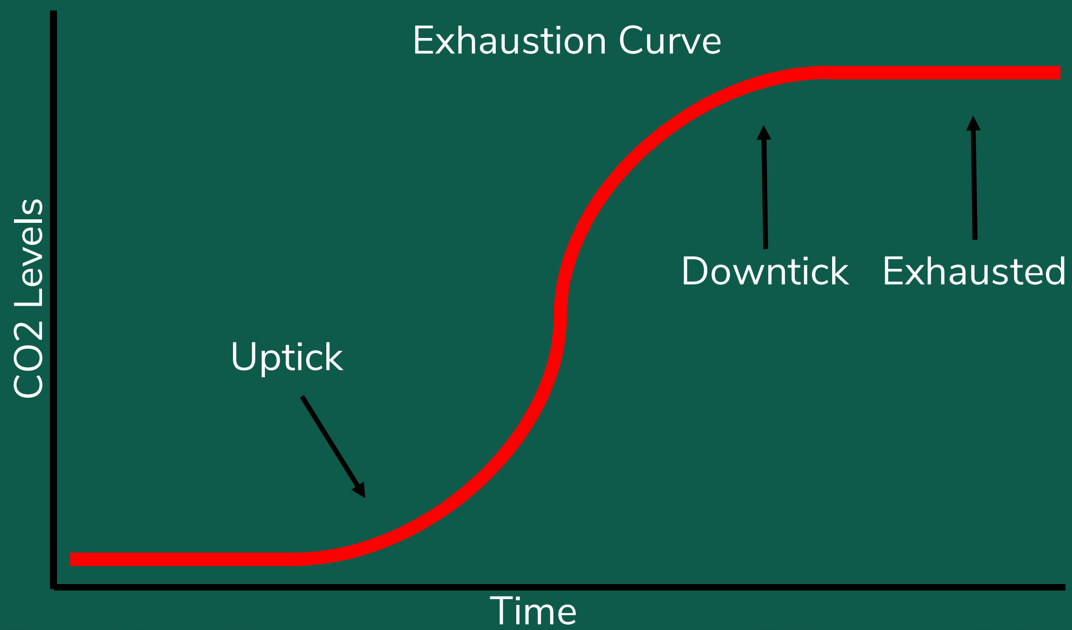
Examples of scrubber media

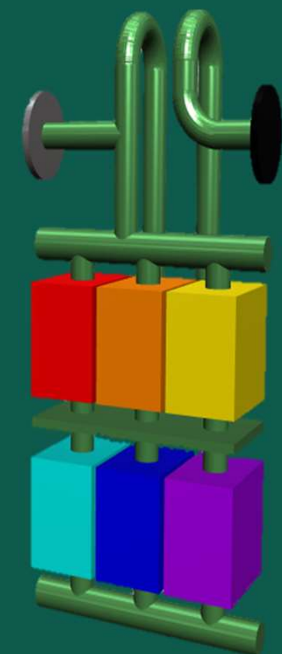
Why monitor the Inlet and Outlet CO2

- Several factors affect Scrubbing capability
- Learn their system better
- Determine efficient meida switch out times
- Faster indication if scrubber isn’t working as expected

Terminology

- Scrubber Medium - CO2 Reactant
- Scrubber Canister - Container for Medium

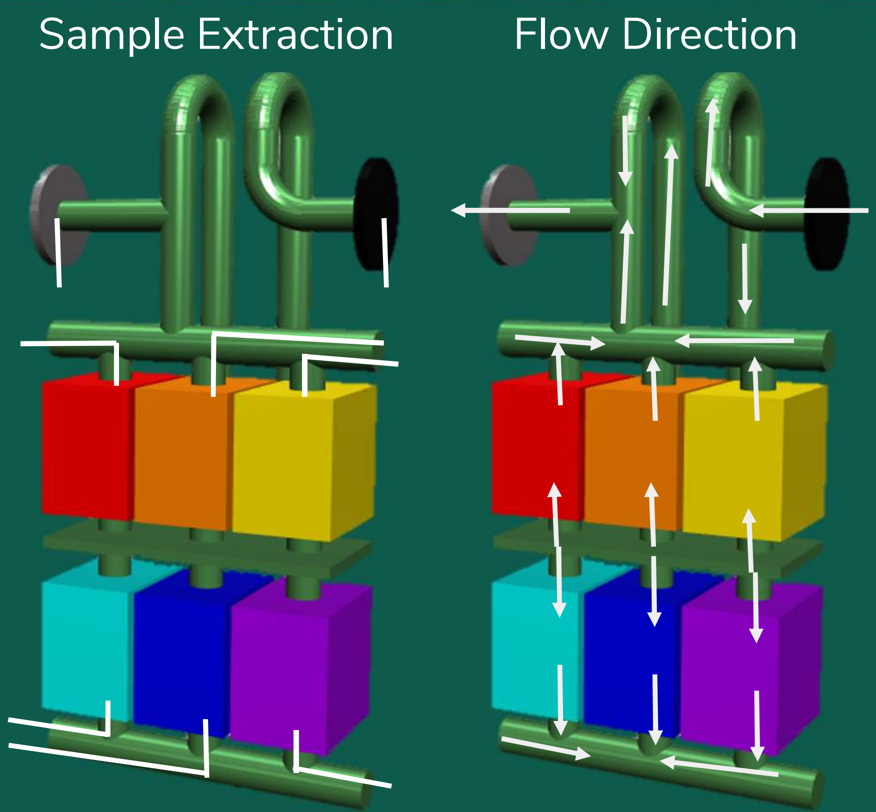




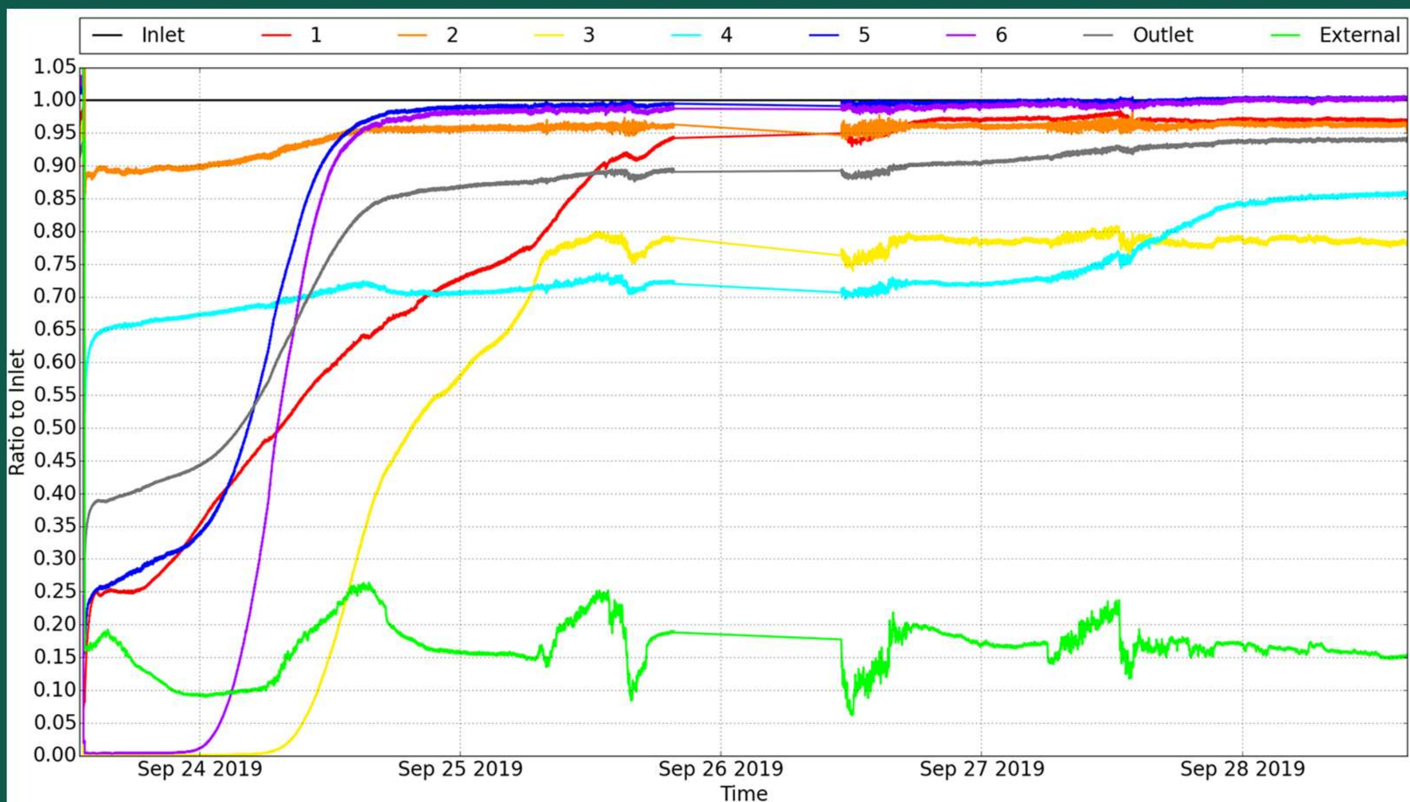
Scrubber System

Experiment Basics

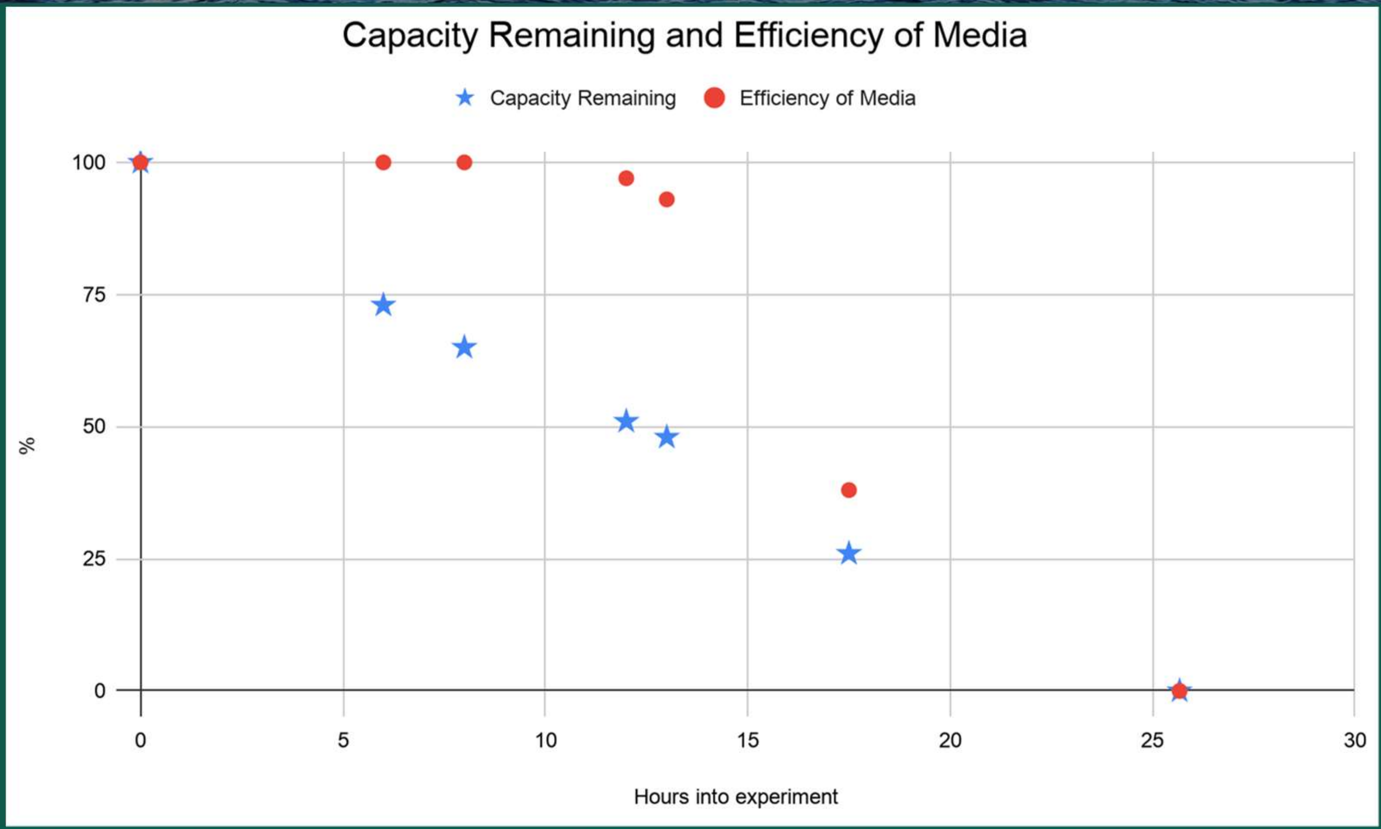
- Flow rate of 90m3/hr was used through the system
- CO_2 level at inlet was set to about 0.7% (which was used as it is the worst case scenario on some submarines)
- Experiments were done when atmosphere was around 50% Humidity



Establishing feasibility

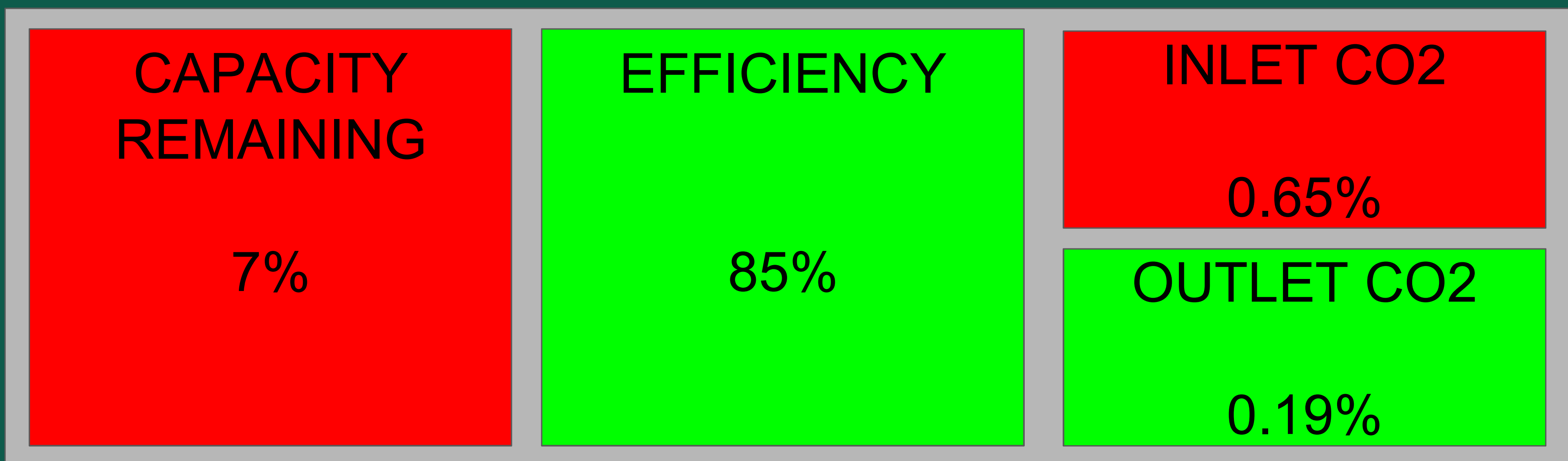


6's Efficiency and Capacity

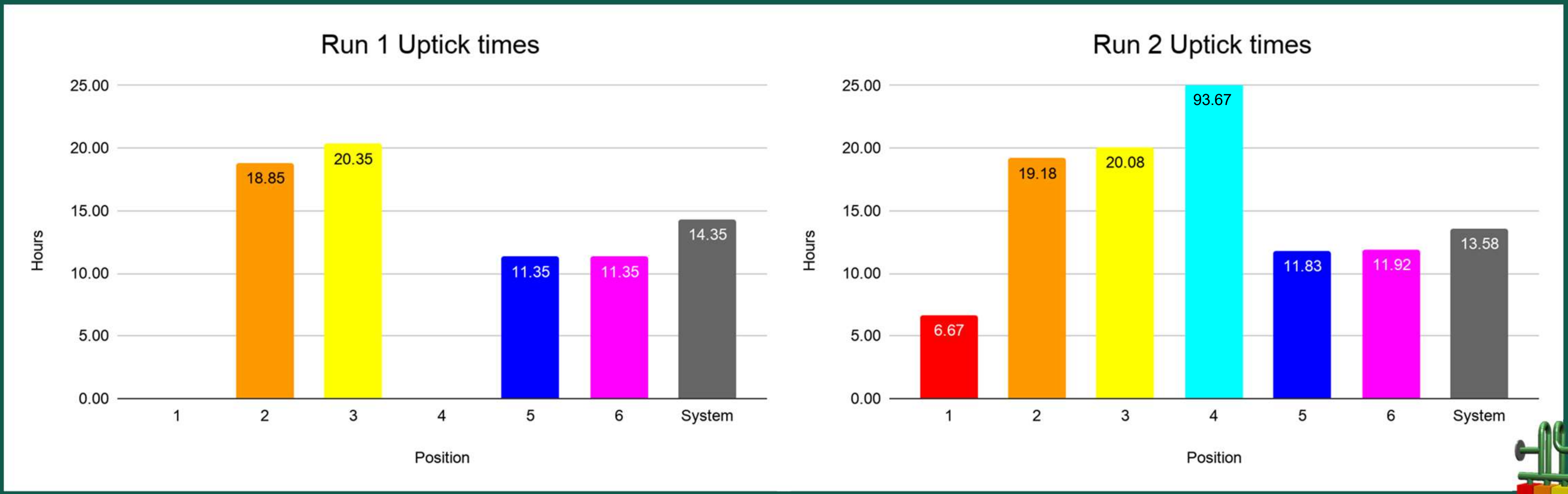


What this means...

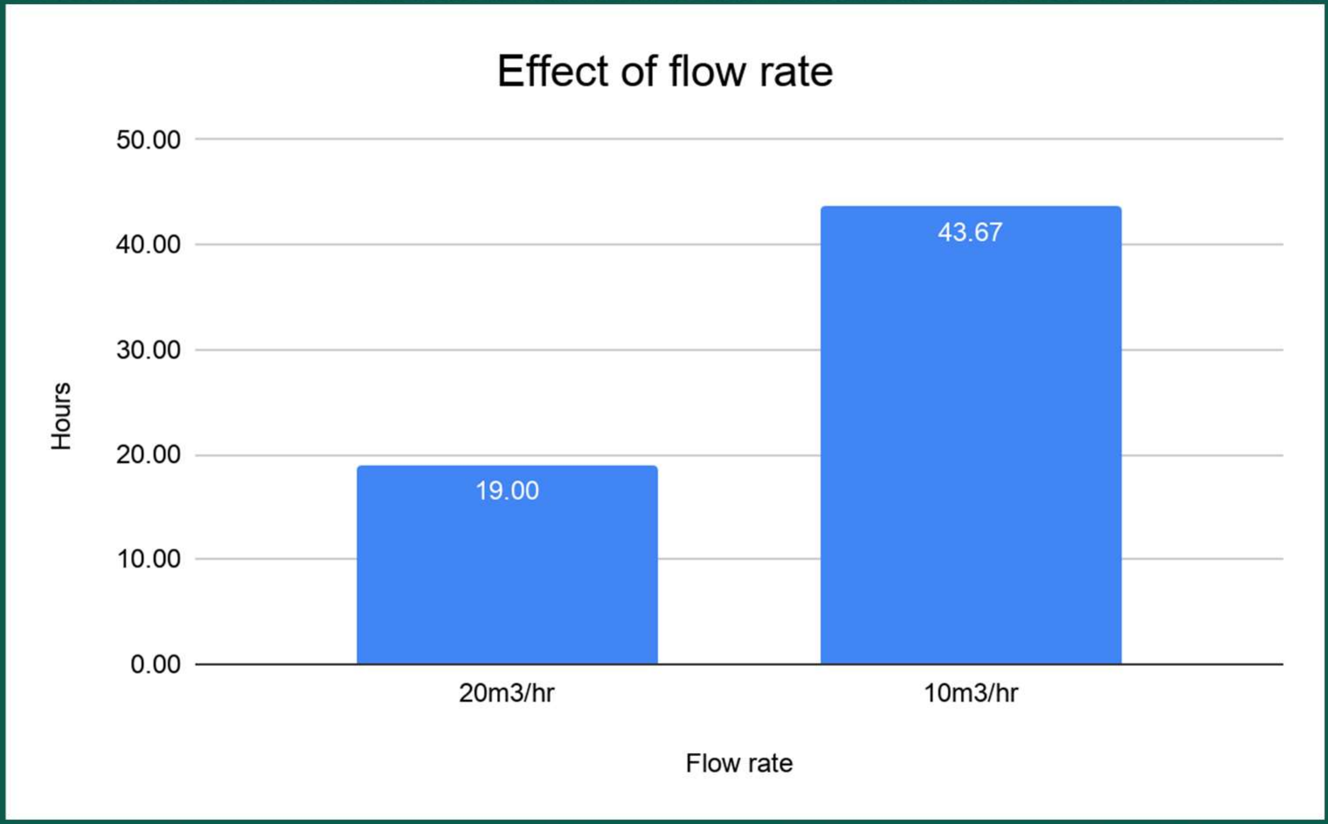
- Able to show real time Scrubber Media Capacity remaining
- Also able to show Scrubber Media Efficiency



Comparison of two runs



Effect of flow rate



Basic Model Assumptions

- 1 kg of CO_2 produced per person per day
- 65 People in a Submarine
- 18 Media are used (or 3 Systems)
- Submarine has a volume of 1,000,000 litres
- System is balanced
- Flow rate 90m3/hr

Switch out time	6 hr	
Media used per day	72	Media x 24hrs/(Switch out)
CO_2 Production kg	65	People x CO_2 per person
CO_2 Removed kg	53.136	CO_2 Removed per Media in switch out time x Media used per day
CO_2 Net kg	11.864	CO_2 Production - CO_2 Removed
% CO_2 rise per day	0.65%	CO_2 Net kg / CO_2 Density

Effect of changing switch out times 6hr/8hr

Switch out time	6 hr	8 hr
Media used per day	72	54
% CO_2 rise per day	0.65%	0.72%

Changing number of Media used at once so % CO_2 rise per day is less than 0

Switch out time	6 hr	8 hr
New number of Media used at once	23	23
New number of Media used per day	92	69

Effect of changing switch out times 6hr/13hr/14hr

Switch out time	6 hr	13 hr	14 hr
Media used per day	72	33	31
% CO_2 rise per day	0.65%	0.94%	0.99%

Changing number of Media used at once so % CO_2 rise per day is less than 0

Switch out time	6 hr	13 hr	14 hr
New number of Media used at once	23	25	25
New number of Media used per day	92	46	43

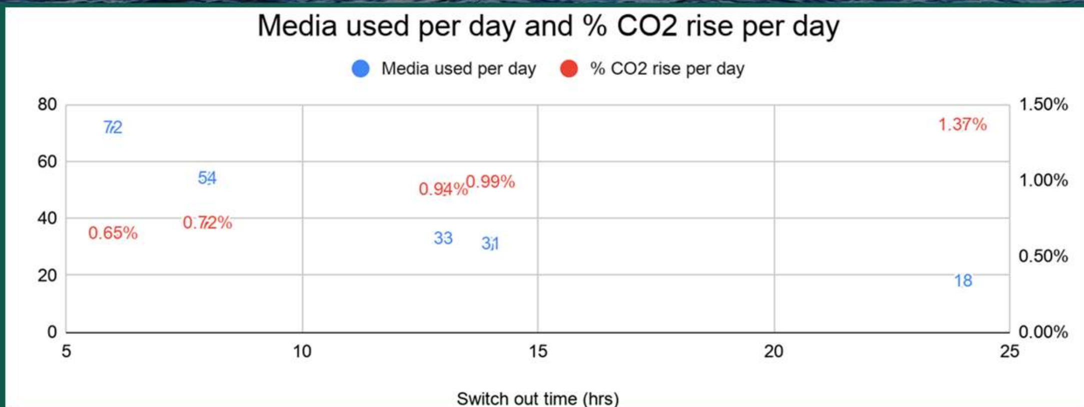
Effect of changing switch out times 6hr/24hr

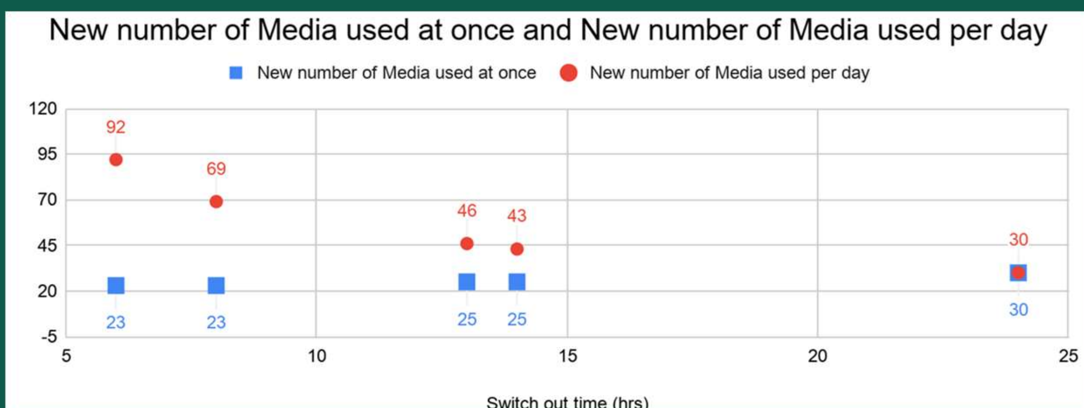
Switch out time	6 hr	24 hrs
Media used per day	72	18
% CO_2 rise per day	0.65%	1.37%

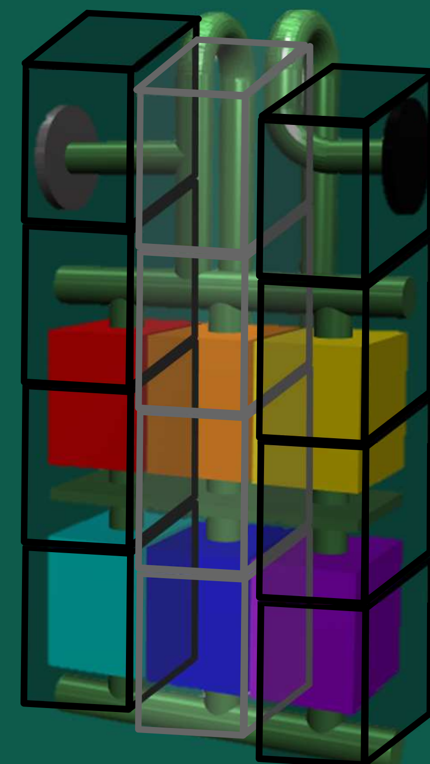
Changing number of Media used at once so % CO_2 rise per day is less than 0

Switch out time	6 hr	24 hrs
New number of Media used at once	23	30
New number of Media used per day	92	30

Effect of changing switch out times







Conclusions

- By monitoring CO_2 scrubbing media efficiency we can alert crew within a reasonable time for media change out
- Differing CO_2 levels onboard and scrubbing capacity (or the number of media) will lead to changing ideal scrubber media changeover times
- Instrumenting scrubbers may be able to reduce the amount of media used

ANY QUESTIONS

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