

Development of a filter for volatile anesthetic agents adsorption during cardiopulmonary bypass.

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Introduction The use of volatile agents during cardiopulmonary bypass allows a “single drug anesthesia” and is associated with reduced peak postoperative troponin levels. Connecting the exhaust systems to the oxygenator's gas outlet port is mandatory and allows to prevent operating room (but not atmospheric) pollution by volatile agents. The aim of this study was to create a prototype filter for volatile agents and to test its adsorption efficacy during an ex-vivo simulated conventional CPB test.

Methods We carried out bench tests to conceive a prototype filter that could prevent room and environment pollution without damaging membrane oxygenators. We performed the tests at the Engineering Center for Circulatory Assistance Laboratory - Dante Pazzanese Institute of Cardiology, São Paulo - Brazil. Bench tests included: simulation of integral adsorption tests; filter dimensions and design; flow versus pressure curve; sizing; and tightness.

Results Calgon AT 410 was the best kind of activated charcoal granules for adsorption of sevoflurane, isoflurane, and desflurane. The results of the pressure versus flow of the prototype filter tests were: large size = 3.5 ± 0.5 mmHg; medium size = 5.0 ± 0.5 mmHg; small size = 6.0 ± 0.5 mmHg. Under cardiopulmonary bypass simulation, 200 g of the Calgon AT450 charcoal was needed for adsorption of sevoflurane, isoflurane, and desflurane for 90 minutes.

Conclusions The last version of the prototype anti-pollution filter adsorbed most of the volatile agents during an ex-vivo simulated conventional cardiopulmonary bypass test.

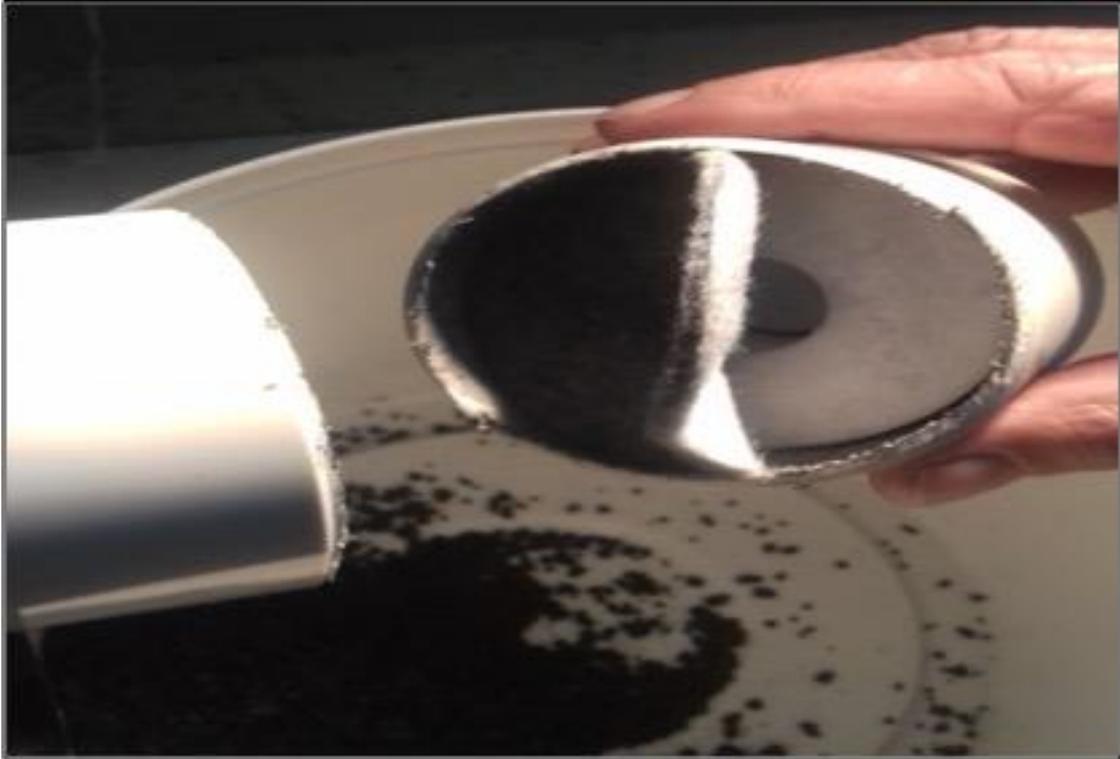


Figure 1: Prototype filters were tested with different types of polypropylene filter elements, which were used inside the filter chamber with the objective of retaining solid material to not pollute the environment, allowing high flow and low-pressure loss

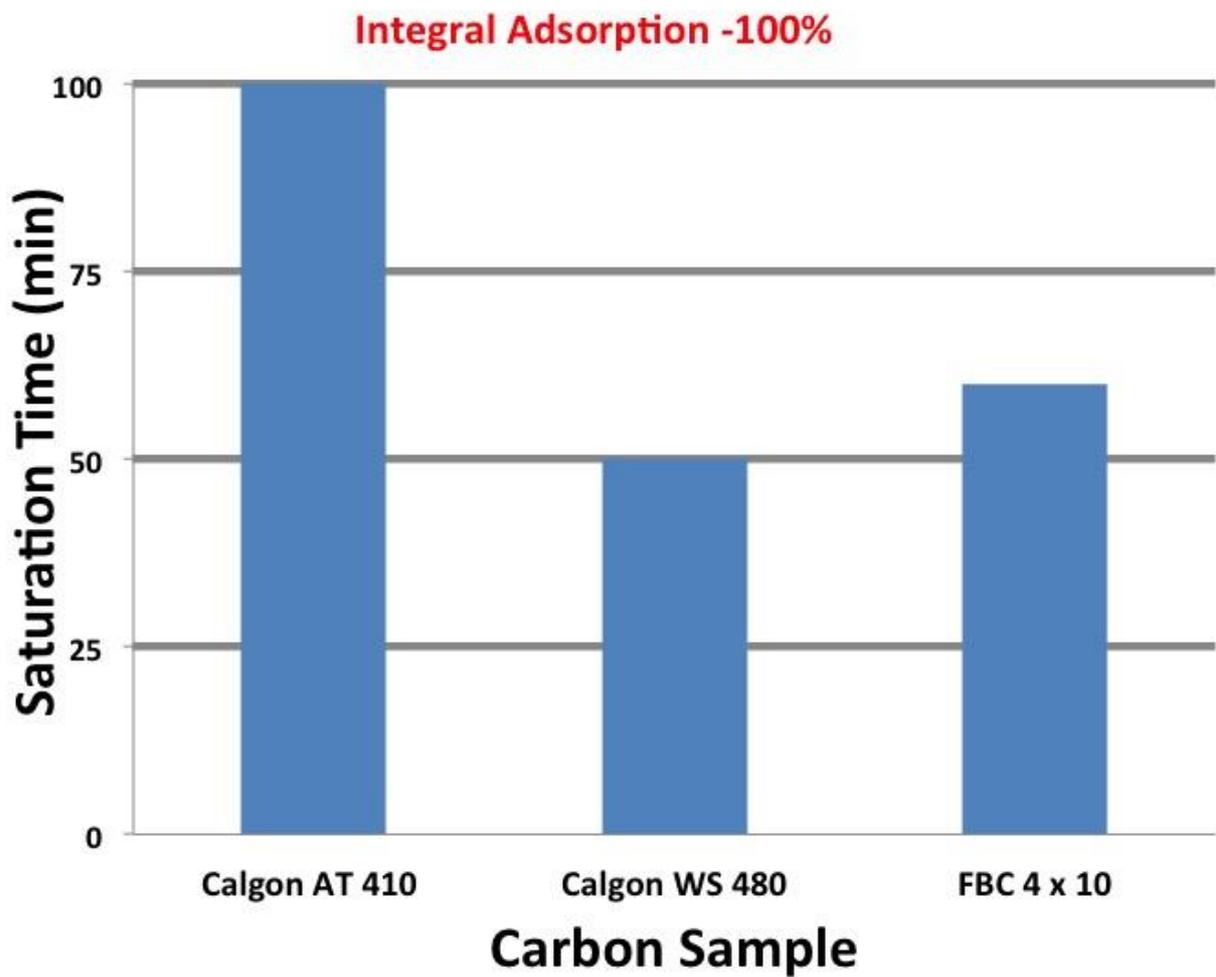


Figure 2: Comparing different sizes and compositions (mineral or vegetable origin), the most suitable with the best adsorption efficiency for all commonly used volatile anesthetics (sevoflurane, isoflurane, desflurane) was the Calgon AT410 granule (AT 410 = 100 ± 5 min; WS 480 = 50 ± 5 min; FBC 4x10= 60 ± 5 min)



Figure 3: Tests were performed using the gas outlet of the Dräger® anesthesia machine, Primus model