

# Ammonia levels and reproductive performance of CD1(ICR) mice in an Optimice® rack using two different styles of cage filters

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## Introduction

Our animal facility uses Optimice racks for breeding mice. We had been using the equipment for 4 years when our cage manufacturer, Animal Care Systems, redesigned their cage filters from a pleated filter to a flat filter. We undertook this study to evaluate breeding performance, cage airflow and ammonia levels in flat filter cages to ensure they were comparable to those in the original pleated filter cages.

## Materials and Methods

Animals were bred on one Optimice rack (Animal Care Systems, Centennial, CO) in pairs (figure 1). Room temperature was set to between 67-69°F, humidity ranged between 30 – 50% and light cycle was set at a 12:12-h light:dark photoperiod. Cages contained shredded aspen bedding (7093, Teklad Global, Envigo, USA) and mice were fed standard rodent chow (diet 2018, Teklad Global, Envigo, USA) (figure 2). Ammonia values were taken at days 3, 4, 5 and 6 post-cage change. Cages were changed every Friday on day 7. Ammonia was measured via a Biosystems (Honeywell) Toxivision IR NH<sub>3</sub> handheld device. Cage air was sampled with the probe at mouse level (1" above bedding level) through a small opening in the cage top of flat filter cages. Cage-level airflow was measured using a Fieldpiece STA2 in-duct hot wire anemometer (Fieldpiece, Orange, CA). Pups were weaned every Monday, between 19-23 days of age. The floor space of Optimice cages (figure 3) is 75 square inches (484 square centimeters). Breeding data were collected as part of standard vivarium protocol.



Figure 1: Optimice racks in BioLink's vivarium.

## Results

Data was collected between October 2014 and January 2015. Reproductive data were summarized for a total of 70 CD1(ICR) breeding units and 169 total litters. Number of pups weaned per litter and wean to born ratio were calculated for total litters born, and the same indices compared between flat filter and pleated filter cages. No differences were found between the two styles of filter cages (table 1).



Figure 3. Floorspace of an Optimice cage.

	No. of Litters	Avg. No. Pups/ Litter	Wean:Born Ratio
All Cages	169	14	0.99
Flat Filter Cages	87	14	0.99
Pleated Filter Cages	82	14	0.98

Table 1: Number of pups weaned per litter and wean to born ratio summarized for total number of litters born, flat filter and pleated filter cages. Breeders produced large litter numbers with an exceptionally high survival rate to wean.

Day	3	4	5	6
Average NH <sub>3</sub> (ppm)	1.9	2.5	3.8	4.9

Table 2: Ammonia levels remained low (less than 5 ppm) over the course of the week for flat filter breeding cages (n=12).



Figure 2: Breeding pair in Optimice cage.

Ammonia values were measured in a randomly chosen flat filter cage every week. Average ammonia remained low throughout the week prior to cage change at day 7 (table 2).

Airflow measurements were within manufacturer recommendations (data not shown).

## Discussion

Our institution has been using the unique low-flow technology ventilated carousel Optimice racks to breed mice in our animal facility for over 9 years. At the time of the study in 2014, the cage manufacturer was redesigning their cage filters from a pleated filter to a flat filter. Even though pleated filters have more surface area for air exchange, the flat filters have added advantages: simpler and exceedingly more economical to replace and maintain, as well as considerably easier to clean. Although there are no upper level ammonia exposure guidelines for mice; for humans, the 8-h time-weighted average exposure limit is 25 ppm or 50 ppm maximal exposure<sup>1</sup>. Since numerous studies have described detrimental health effects of increased ammonia levels on laboratory rodents<sup>2,3,4</sup>, we wanted to validate that the flat filters could maintain adequate air quality in breeding cages (i.e., high biomass cages), as measured by ammonia levels and airflow measurements. Airflow measurements were within manufacturer recommendations and ammonia levels remained low (<5 ppm) over the course of our one-week cage change interval. There was no significant difference in breeding performance between both styles of filter cages. The average number of pups weaned per litter was 14 for both filter types, comparable to the vendor average of 12-14 pups per litter (Charles River Laboratories, pers comm). The Jackson Laboratory website also publishes that an exceptional breeder regularly produces 8 or more pups per litter<sup>5</sup>. Our breeders, regardless of filter type, produced large litter numbers with an exceptionally high survival rate to wean.

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## References

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- <sup>4</sup>Sanford AN, Clark SE, Talham G, Sidelsky MG, Coffin SE. 2002. Influence of bedding type on mucosal immune responses. Comp Med 52:429-432.
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