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Evaluation of Particulate Air Filters for Indoor Air Cleaning

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species was taken during March and June (Froeschner, 1962). Hungerford (1933) reported this species was collected every month except January and February, but noted that it was observed swimming under ice in Ithaca, N.Y., during early February. Arkansas specimens have been taken every month except May.

Notonecta raleighi (Bueno) was first reported from Arkansas by Harp and Harp (1980). Materials at hand show 116 individuals in 48 collections in 27 counties (Fig. 5). It has been collected in all five ecoregions of Arkansas, but seems to be most common in the southern portion of the state. Foreschner (1962) reported this species to be uncommon in Missouri, being collected only from large ponds and a pool area of a nearly dry stream bed. Wilson (1958) reported this species to be fairly common in Mississippi, being taken from a wide range of aquatic habitats except for running streams and borrow-pits. Collections in Arkansas are from habitats similar to those reported by Wilson (1958). Missouri specimens of this species were taken during March, June and October (Froeschner, 1962). Arkansas specimens of this species have been collected every month except April, July and December.

Notonecta uhleri (Kirkaldy) has not previously been reported from Arkansas. It is the least common notonectid species in the state, being now known from only 12 individuals having been taken in eight collections from seven counties (Fig. 6). Of the eight collections, three were from the Ouachita Mountains, two were from Crowley's Ridge, and one each from the Mississippi Alluvial Plain and Gulf Coastal Plain. Wilson (1958) reported this species to be very uncommon in Mississippi, being collected from a roadside borrow-pit and a deep stream, neither of which had vegetation, but Froeschner (1962), while listing it, had no record of its occurrence. Arkansas specimens have been collected from a farm pond, pool areas of rivers or creeks and a lake. All collection sites contained turbid water; vegetation was present in all habitats except the lake. Hungerford (1933) reported this species to have been collected during the months of July-October. Wilson (1958) reported taking it in August and October. Arkansas specimens were taken during March, April and October-December.

Notonecta undulata (Say) was first reported from Arkansas by Hungerford (1933). It is a common and widespread species in Arkansas, being represented by 205 individuals in 54 collections from 23 counties throughout the five natural divisions of Arkansas (Fig. 6). The majority of the collections of this species have been taken from the eastern portion of the state. Hungerford (1933) thought this species to be "the most common species in the United States". This species is similar in size and color pattern to *N. indicia*, and therefore these two species are often confused for each other (Hungerford, 1933). Further, causing even greater confusion, these two species are often collected together in the same sample. Froeschner (1962) reported this species to be very common in Missouri. Conversely, Wilson (1958) listed this species but had no record of its occurrence in Mississippi. Missouri specimens were collected from ponds and quiet sections of rivers (Froeschner, 1962). Arkansas specimens have been taken from most aquatic habitats, including swimming pools. Missouri specimens of the species were collected from January to July (Froeschner, 1962). Hungerford (1933) reported collections of this species for every month of the year. Arkansas specimens of this species have been taken during all months except July.

From present knowledge, it is probable that all eight notonectid species can be collected during any month of the year in Arkansas. Most should be found in any of the state's ecoregions. *B. confusa* and *N. uhleri* may be restricted in their habitat preference, however. The former appears to prefer clear well-vegetated waters, whereas the latter prefers turbid water with mud substrates.

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EVALUATION OF PARTICULATE AIR FILTERS FOR INDOOR AIR CLEANING

Indoor Air Quality is a growing health concern. Efforts are currently being made to reduce pollutants and to prevent illnesses resulting from inhalation of allergens and pathogens at home and in the workplace. Without adequate air filtration in the heating, ventilation, and air conditioning (HVAC) system, air pollutants may distribute through the house or building, or the HVAC system may become a source of allergens and pathogens.

In this study several types of filter were evaluated for their effectiveness in removing airborne particles in the size range of 0.2 to 1.0 μm in diameter and for the energy requirements associated with the filtration. Tested were: (1) a pleated paper type filter, (2) a 7.5 cm thick, medium efficiency pleated electret filter, (3) a 15 cm thick, High Efficiency Particulate Air (HEPA) electret filter, and (4) a standard fiberglass HVAC filter. The electret filter material consists of fibers having a semi-permanent charge which enhances collection efficiency through electrostatic attraction of the aerosol particles. Each of the filters was about 0.37 m^2 in cross section with the actual filter surface area varying depending on the thickness and number of pleats.

The filter evaluation tests were performed in a single residence with a volume of about 360 m^3 and having a 'central' HVAC unit. The evaluation procedure was adapted from "Draft Standard AC-1" of the Association of Home Appliance Manufacturers (1985), which gives guidelines for evaluating portable room air cleaners. For each filter, measurements were made of the effective Clean Air Delivery Rate (CADR) and the energy consumption rate.

When tested using a closed loop, recirculating system as in this study, the CADR is defined as the product of the total air flow rate, the particulate collection efficiency of the filter and a factor for the inefficiency of mixing within the test volume. A high CADR is desirable, particularly when accompanied by low energy consumption.

To measure CADR a high concentration of smoke from burning incense was distributed throughout the house. An optical particle counter (Climet model CI-7400) was used to monitor the concentration of particles in the air near the inlet to the air circulation system. Concentrations of greater than 3×10^8 particles/m^3 were obtained for particles with diameters between 0.2 and 1.0 μm. After extinguishing the incense sticks, a filter was installed at the fan inlet and the particulate concentration was monitored continuously for a period of one hour or until the concentration dropped to less than 50% of its original value. The procedure was repeated for all the filters and then with no filter installed.

The change in particulate concentration was modeled as an exponential decay such that the concentration, C(t), at time t was given by

$$C(t) = C_i \exp(-K\ t),$$

where

Ci = initial concentration, and
K = decay constant.

A linear regression was used to determine the decay constants from the measurements. The CADR for the system with the filter in place was calculated by

$$CADR = V * (K_e - K_n),$$

where

V = volume of the test chamber,
Ke = decay constant with the filter in place,
Kn = natural decay constant with no filter in place.

Flow rate and Pressure Drop were measured with each filter and used to calculate the energy consumption rate, W, in watts.

$$W = 0.0166 * Q * \Delta P,$$

where

Q = volumetric flow rate in m^3/min,

and

ΔP = pressure drop across the filter in Pascal.

The Clean Air Delivery Rate and Energy Consumption Rate results are given in Table 1. The exponential decay model of particle concentration versus time for each filter is presented in Figure 1.

Table 1. Test results for the evaluated filters.

FILTER	FLOW (m^3/min)	ΔP (Pa)	CADR. (m^3/min)	POWER (W)
Standard Fiberglass	24.64	12.5	.058	5.10
Pleated Paper	23.93	21.3	4.09	8.43
3 inch Electret	24.07	40.0	12.89	15.96
6 inch Electret	19.54	137.5	14.04	44.54

General Notes

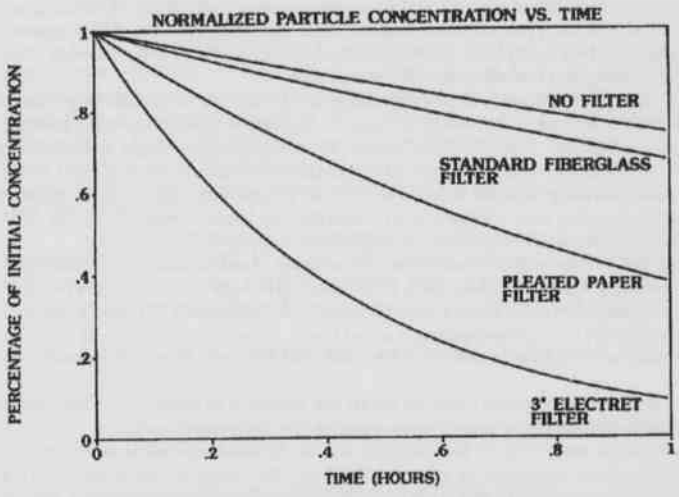

Figure 1. Best fit exponential decay of particulate concentrations with time in the test residence for each of the filters tested. The fit for the 15 cm electret filter is not shown as it fell nearly on top of that for the 7.5 cm electret filter.

The relative merits of each filter type are as follows:

(1) Pleated Paper Filter - This type demonstrated appreciable particulate removal ability in the submicrometer size range with moderate energy consumption.
(2) Electret Filters – The electret filters yielded the best small particle collection ability of those tested. The 7.5 cm electret gave 92% of the CADR of the 15 cm electret with only 36% of the energy consumption. The 15 cm electret loaded the blower, reducing the air flow rate resulting in a lower CADR than would otherwise have been expected.
(3) Standard Fiberglass Filter – The merits of this type include compatibility with existing HVAC systems and low cost. Small particle collection ability is minimal. Energy consumption is low.

The CADR numbers should be interpreted with caution. They are specific to the test aerosol and to the test chamber and air handling system. The CADR numbers for different filters can only be compared when all other factors in the determination of the numbers are the same. High CADR numbers are given by high filtration efficiencies. However, a maximum CADR exists which depends on the volumetric air flow rate and the mixing factor for the house. Therefore, continuing to increase the filtration efficiency will add little in terms of improved air quality but will increase energy consumption. Additional work in this study will be aimed at determining optimum filtration efficiency when both air quality and energy consumption are considered.

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THE VASCULAR FLORA OF PERRY COUNTY, ARKANSAS; A PROGRESS REPORT

Located in western, central Arkansas in the Ouachita Mountain Division, Perry County lies in the center of the Fourche Mountain Subdivision immediately below the Arkansas River Valley Subdivision of the Interior Highlands. The vascular flora of this county is poorly known; Perry County ranks at 56 of the 75 Arkansas counties for the number of known taxa (Smith, 1988. An atlas and annotated list of the vascular plants of Arkansas. Kinko's, 653 West Dickson Street, Fayetteville, AR. 72701). Community types represented in the County range from hydric sites (cypress swamps; ponds, streams and river banks) to bottomland hardwood forests, to pine forests, to upland hardwood forests, cedar glades and bluffs; included are disturbed sites ranging from hydric to xeric.

Numerous collection trips concentrated over the last year during the spring, summer and fall growing seasons have been made to sites representative of these community types. Currently 134 county records of vascular species have been identified. Voucher specimens are deposited in the herbaria of UCA and UARK. This current list is published with the Arkansas Native Plant Society as an Occasional Paper and may be obtained from Dr. James H. Peck, Biology Dept., University of Arkansas at Little Rock, 2801 S. University Ave., Little Rock, AR 72204.

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BACTEREMIA ASSOCIATED WITH MORTALITY IN AN ARKANSAS ALLIGATOR

Death from gram-negative septicemia has been reported several times in reptiles. In alligators this has been associated with populations that had been stressed due to changes in the natural or captive environment (Shotts *et al.*, 1972; Gordon *et al.*,1979). It is believed that the bacteria gain entrance to the blood stream of infected reptiles by natural or surgical wounds (Cooper, 1981). We report a case of death in an adult alligator associated with a septicemia or bacteremia in which the most prominent organism isolated was *Aeromonas hydrophila*. The alligator had been obtained from the wild but had been living isolated away from a natural or translocated population of alligators. The only significant pathology found on postmortem examination was minute hemorrhagic lesions in the gastrointestinal tract, which could have provided the bacteria entrance to the circulatory system.

A large, male alligator was captured on an embankment of a small, impounded lake on a geological elevation of the Mississippi delta known as Crowley's Ridge in East-Central Arkansas (St. Francis Co.) on March 10, 1985. The animal was known to have resided in the area for many years on this uplifted region, which is approximately 30 miles from the nearest known alligator population on the St. Francis River. The original territory and time of the alligator's arrival on Crowley's ridge are unknown. The alligator was 305-cm long (snout to tip of tail) and weighed 114-kg. The animal was recently deceased when captured and was immediately transported to the Arkansas State Livestock and Poultry Commission Laboratories in Little Rock for postmortem examination and collection of laboratory samples. The alligator had been seen alive the previous day and its heart muscle was still active when examined, therefore the time elapsed from death to postmortem examination was estimated to be less than12 hours. Aseptic culture specimens (3 samples each) were taken as follows: Aerobic and