Application Bulletin

Lignite-Based Activated Carbon & Fungal Proliferation in Demineralizer Terms

ULTRAPURE WATER™, MARCH 1988

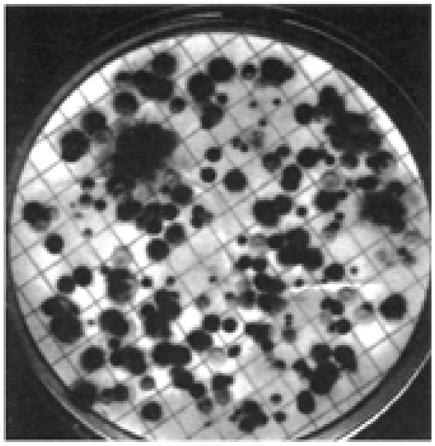
Three demineralizer trains of the East Kentucky Power Spurlock Station, Maysville, KY, were examined to determine why slime was present in two of the treatment trains. Each train has an activated carbon filter column, a cation exchanger, an anion exchanger, and a polishing mixed-bed ion exchanger. The presence of slime resulted in a decrease in efficacy of the treatment system, with a concomitant decrease in the quality of water entering the boilers.

A membrane filtration technique, using Rose Bengal Agar containing penicillin and streptomycin, was used to isolate slime-producing fungi from groundwater and the three train compartments. In trains 1 and 2, the number of fungi increased significantly from the carbon vessel to the cation unit, but decreased from the cation to the anion units, and slightly increased from the anion unit to the mixed-bed vessels.

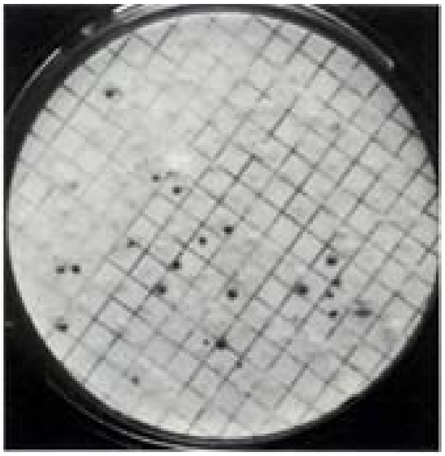
The slime-producing fungi were *Fusarium merismoides*, *Exophiala kentuckensis*, *Benewoski spp.*, and *Candida humicola*. *F. merismoides* was the predominant fungus associated with the cation vessel laterals, while *E. kentuckensis* was dominant in the anion and mixed-bed units of these two trains. See Figure 1.

TRAIN # 1

Figure 1. Four-day old cultures of Fusarium (large pink colonies) and Exophiala (dark green colonies) on Rose Bengal Agar, taken from demineralizer trains prior to treatment with biocide and installation of bituminous-based charcoal.

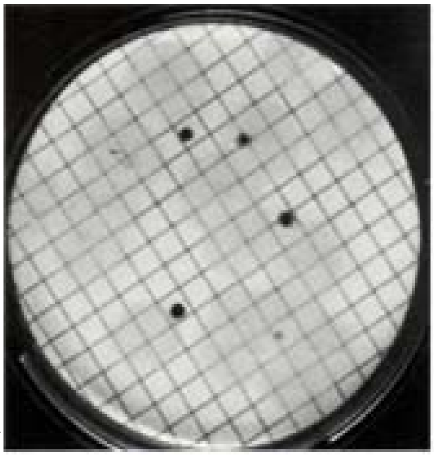


TRAIN # 2



BEFORE

Figure 2. Four-day old cultures of Fusarium (large pink colonies) and Exophiala (dark green colonies) isolated on Rose Bengal Agar, taken from the laterals of demineralizer trains before and after treatment with biocide and installation of bituminous-based charcoal.



AFTER

Visual inspections and TOC determination of demineralizer trains and their effluents should be performed regularly to monitor the efficacy of the activated carbon.

Significantly lower numbers of these same fungal isolates were detected in train 3. Since fungi were isolated from all three demineralizer trains, as well as from the surface water, carbon column, and cation unit of a demineralizer train located at another East Kentucky Power plant, it must be assumed that fungal presence in the demineralizer trains was normal. What was unique to trains 1 and 2 was the degree of proliferation of the slime-producing fungi. See Table A.

Table A

Comparison of Demineralizer Trains
Spurlock Station

	Train 1	Train 2	Train 3	Dale Station
Carbon	2.0*	3.0	28	25
Cation	492	1511	3	17
Anion	121	321	7	n/a
Mixed bed	231	490	1	n/a

*Fungal colonies/ml, Rose Bengal Agar

Physicochemical parameters (pH, temperature, conductivity, and total organic carbon) were examined to determine if any correlation existed between them and slime proliferation. Total organic carbon (TOC) was the only major difference observed between the first two trains and train 3 that might account for fungal proliferation. The effluent sample TOCs indicated that the activated carbon of trains 1 and 2 was only 50% efficient in removing the organic carbon from source water; the activated carbon of train 3 was 80% effective. Organic carbon leaching was apparently responsible for slime-producing fungal proliferation. The activated carbon in trains 1 and 2 was lignite based, whereas train 3 was bituminous-based coal.

To control the slime-producing fungi, the activated carbon of demineralizer trains 1 and 2 was changed to a bituminous-based carbon. This was followed by treatment with a slimicide (2,2 dibromo-3-nitrilopropionamide). Samples collected from trains 1 and 2 two weeks later exhibited a 92% reduction in the fungal population. See Table B and Figure 2. The bituminous-based carbon effluent revealed a lower TOC than previously observed from the lignite-based carbon.

Table B

Comparison of Isolates from Demineralizer Trains Prior to and After Treatment with Biocide and Replacement of Carbon

Location	Fusarium merismoides		*Exophiala kentuckensis		Benewoski species		Candia humicola	
	Before	After	Before	After	Before	After	Before	After
Train #1								
Carbon	0	0	0	0	0	0	0	0
Cation	12	71	440	70	0	0	0	0
Anion	0	0	105	0	0	0	0	0
Mixed Bed	0	0	150	3	0	0	0	2
Train#3								
Carbon	0	0	0	0	0	0	13	0
Cation	840	3	600	15	61	1	0	2
Anion	8	5	250	8	2	0	57	0
Mixed Bed	60	2	272	10	0	0	134	5
Train #3								
Carbon	1	0	2	1	0	0	25	0
Cation	1	2	1	20	0	0	0	1
Anion	0	5	5	4	0	0	0	0
Mixed Bed	0	1	1	4	0	0	0	1

Fungal colonies/1 ml Rose Bengal Agar
*Exophiala kentuckensis is a proposed new species.
Demineralizer Trains #1 and # 2 were treated with Betz Slimicide 508 and the lignite based carbon was replaced with a bituminous based charcoal.
Demineralizer Train #3 was not treated with the slimicide and the carbon was not replaced. **ULTRAPURE WATER¨, MARCH 1988**

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