Molecular Sieves for Film Preservation

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This paper reviews the current status of the zeolite molecular sieve technology for film preservation since its introduction in 1993. We have successfully developed products and procedures for motion-picture, microfilm, and aerial film segments and disseminated the information to the preservation community (1-5). The molecular sieves scavenged the acids, moisture, oxidants, and solvents generated by the films under confined storage,thus suppressing the acid-catalyzed hydrolytic degradation of the cellulose triacetate (CTA) support and the resulting loss in dye stability of color motion-picture films.

Subsequent practical tests (6) conducted at various archives worldwide confirmed the results of the accelerated laboratory tests that molecular sieves are indeed effective acid-scavengers under any storage condition (2 to 30 C and between 20 to 70% RH). Also, the degradation levels of CTA films substantially increased with the processed vintage of the roll film (from zero to forty years) even under cold/dry storage conditions. Significant reduction in acidity was observed if the acidic fumes were expelled periodically by constant use of the roll film even under ambient storage. These data implicated the autocatalytic nature of the CTA film degradation.

The initial accelerated laboratory tests on the eighteen different motion-picture color negative films (1) started in 1992 were continued up to four years of incubation. The dye stability data after 1520 days of incubation are now reported on the same films in the presence or absence of molecular sieves (in Table I) under confined incubation conditions. The free-hung incubation data are also included for reference purposes.

The data in Table I are based on the predicted time (years) at 21 C. The percent change in statistics for yellow, magenta, and cyan dyes show that the yellow dye stability is increased up to 400% due to the presence of molecular sieves on all the eighteen films tested between 30 to 70% RH, and is higher than the free-hung predictions. Similar results were also noticed with magenta and cyan dye stability data with >/= 95% confidence (denoted by "*" symbol) with varying degrees of improvements on different dye sets.

The molecular sieves are currently used to combat the vinegar syndrome, to arrest oxidative attack on silver-gelatin films, to extend the keeping of older nitrate films, and to address other concerns resulting from the natural aging of imaging materials.

Table 1. Percent Change Statistics for Yellow Dye (Statistical Analysis of the 18 films used in Ref. 1,"The Effects and Prevention of 'Vinegar Syndrome'" after 1520 days of incubation)

RH	Avg % Change MS vs. Free Hung	Min % Change	Max % Change	No. of Products
30	23.297*	-2.063	76.92	15
50	471.240*	158.336	990.07	18
70	435.774	-28.547	1968.79	16
RH	**Avg % Change MS vs. Free Hung**	**Min % Change**	**Max % Change**	**No. of Products**
50	392.242*	163.872	930.910	18

Percent Change Statistics for Magenta Dye

RH	Avg % Change MS vs. no MS	Min % Change	Max % Change	No. of Products
30	-8.573	-26.2081	31.841	4
50	81.313*	50.5318	167.401	8
70	391.962*	55.9966	678.287	5
RH	**Avg % Change MS vs. Free Hung**	**Min % Change**	**Max % Change**	**No. of Products**
50	-14.649	-61.4617	16.619	7

Percent Change Statistics for Cyan Dye

RH	Avg % Change MS vs. no MS	Min % Change	Max % Change	No. of Products
30	-1.433	-30.4902	24.592	6
50	32.669*	-57.4953	102.973	12
70	181.526	18.3947	418.321	5
RH	**Avg % Change MS vs. Free Hung**	**Min % Change**	**Max % Change**	**No. of Products**
50	53.005*	-5.82032	91.5998	8

* indicates number is significantly different from zero, with >= 95% confidence

References

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