The Role of a Film Manufacturer in Motion Picture Preservation

presentation by Eastman Kodak Company
to 1993 Hearings of the National Film
Preservation Board of the Library of Congress

January, 1993

As one of the world's leading manufacturers of film products, Eastman Kodak Company plays an active role in the fight to preserve America's motion picture heritage. Today I want to outline briefly how we pursue that struggle and some of what we have learned from it.

For us, the fight is centered in our research labs where much work is devoted to the issues surrounding image stability. We share our results in articles published in a variety of technical journals, and in presentations to preservation organizations, such as AMIA and FIAF.

We support those organizations, and also help fund the work of several independent labs, including IPI (the Image Permanence Institute at Rochester Institute of Technology in Rochester, New York) and the Manchester Polytechnic Institute in the UK.

And we maintain extensive personal contact with film archives, vaults, studios and preservation professionals around the world.

To give us our own practical experience in archiving -- and to offer the industry an additional film storage site -- we're building a film preservation area in our new Hollywood facility. Temperature, humidity and other storage conditions will, of course, follow NAPM/ANSI standards and recommendations.

I say "of course" because we work closely with NAPM/ANSI, SMPTE, IS&T and other groups to develop those standards and recommendations.

These recommendations come from work
on the two major chemical issues in film
preservation:
the stability of the dyes in color films and
the stability of the film support material.

The fading of color dyes is a result
of chemical reactions that occur within the film
at all times -- even when the film is stored
in the dark.

We have learned a great deal about these
reactions.
We know, for example, that higher temperatures
and humidities accelerate them.

We use this knowledge to develop "accelerated
aging tests" --
tests that simulate long term storage and
predict the life expectancy of a film image.
And we use these predictions,
-- or "Arrhenius data," --
to establish storage recommendations,
which stress strict temperature and humidity
limits.

But dye stability is only one of the criteria
a film designer must consider.
Others include grain, sharpness, color
reproduction -- and cost.
These criteria often conflict and must be
prioritized based on the film's intended use.

35mm color print film is primarily intended
for use in theatrical release prints.
Usually, a large number of prints are produced
at the same time.
They circulate from theater screen to screen
and, after a relatively short time, are destroyed.
In other words, color print films are NOT
intended to be a medium for long term storage.

The most effective way to preserve color films
is to make black-and-white separation masters.
We are currently trade testing a new generation
separation film.

However, we recognize that other pre-print
material, such as original negatives and
color intermediates from which master
positives and duplicate negatives are made,
as well as actual prints, are often held
for long term storage.

Just last year, we introduced a new color intermediate film with greatly improved dye stability.
And a few years ago we introduced a low-fade color print film with dye stability of more than 100 years when properly stored.

Let me turn now, from dye stability to the stability of the film support.
As you know, from 1890 to1949 cellulose nitrate was the standard support for 35mm film.
In 1949 we introduced cellulose triacetate (CTA) or "safety base" 35mm film, non-flammable and more resistant to decompostion.
By 1951 we ceased manufacturing nitrate films as acetate base had become the world standard.

But when polyester was invented in the 1950s, we began investigating its use as a film support material.
We found that it has many physical and chemical properties that can help a film meet long term storage requirements.
In 1955 we manufactured our first film on polyester base.

Today, we manufacture film on both acetate
and polyester base.
Each has applications for which it is
particularly well suited.
Because its dimensional stability,
polyester base is ideal for long term storage.

We especially recommend the polyester versions
of the black-and-white films we've designed
specifically for preservation and restoration
work.
These include intermediate films used for
making interpositives and dupe negatives
from nitrate originals and, of course, the film
used for making black-and-white separations.

However, a great deal of material is currently
stored on acetate base film,
and a few years ago we all became aware
of the previously unrecognized threat of
acetate decomposition -- often called
"the vinegar syndrome."

Cellulose triacetate results from a chemical
reaction between cellulose and acetic acid.
Acetate decomposition (or deacetlyation)
is the reverse reaction: the acetate ion
reacts with moisture to form acetic acid.

The acid produces the characteristic vinegar odor.

Excessive moisture and acetic acid are the prime catalysts for the reaction.
And since the reaction itself produces acid, it is "autocatlytic:" once it begins, it can't be stopped.

Furthermore, when the film is stored in closed containers, the acetic acid also hastens the fading of the color dyes.

Last December, at the AMIA conference, we spoke about using molecular sieves as a potential weapon against vinegar syndrome.

Molecular sieves are crystals that absorb molecules of various substances.
Unlike other absorbents, they can "choose" what they absorb; each type of "sieve" allows only certain size molecules to be absorbed.

Our studies involved crystals that absorb, among other compounds, water and acetic acid.

Accelerated aging tests suggest that
packing them in the container used to store film,
can extend the life of the film far beyond
what is now considered normal.

By absorbing the moisture and acetic acid
from the containers, the molecular sieves
effectively deterred the vinegar syndrome's
effects.

Our attitude to these results
is similar to that of drug companies
in the midst of developing a new remedy;
we need further research to make sure
there are no harmful side effects.
In addition to continuing work in our own labs,
we are about to begin trade trials of
molecular sieves with a number of customers.

We think it's an extremely promising technology,
but the industry will be its final judge.
And if molecular sieves are used in the future,
it will be in combination with current storage
recommendations.

Those recommendations, with their strict
temperature and humidity limits,
remain the most effective weapons
we have against both dye fading and base
decomposition.

However, you may have seen some press
releases about an electronic technology
Kodak is pursuing that has the potential
to restore faded, scratched and physically
damaged film.
It involves digitizing film material
so it can be electronically manipulated,
then transferred back to film with no loss
in photographic resolution or color reproduction.

Once a film is digitized, scratches and other
damage could be repaired. Missing image data
(such as parts of frames lost to decomposition)
could be copied from an undamaged frame
to produce a restored image.
The results would then be recorded onto
a high resolution intermediate film
from which new prints could be made.

Currently, this technology is relatively
expensive to use.
But we expect that a steady reduction in its cost
will make it more practical in the future.

If ever there were a good fight, it is the fight
to preserve the art of the motion picture.
Kodak is proud to be part of that fight,
and plans to continue its research
to help preserve the films of yesterday,
and make the films of tomorrow even better.