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REPORT ON THE ANALYSES OF RECOVERED 1201-3 FILM SAMPLES

(KODAK High Definition Aerial Film 1414 (ESTAR Ultra-Thin Base)

1201-3

SUMMARY:

Seven pieces of 6.6 inch wide KODAK High Definition Aerial Film 1414 (ESTAR Ultra-Thin Base) were received for evaluation. Examination of salvaged material indicates the film separated into pieces due to externally and rapidly applied forces. After extended soaking, the emulsion adhesion characteristic was reduced.

DISCUSSION:

Seven wet pieces of Type 1414 film were received for processing and analysis after having been immersed in sea water approximately nine months at a temperature of about 1.5°C and 7,100 psi. The film was assessed to be unprocessable due to extensive loss of emulsion, distortion of the fragments, and the need to dry the pieces before splicing. The pieces were only air dried to facilitate analyses.

a. Handling

Attempts were made to reassemble the pieces as a continuous length of 6.6 wide film. Only two pieces had one common irregular shaped matching edge. See Figure No.1 (Parts 1 and 2). This match-up was made after the pieces were dried

b. Lengths

Four lengths are about 58 inches long. This is approximately one-half the circumference of a roll with an overall diameter of about 34 inches. The one piece (Part 7) is 93 inches long and is probably one outer convolute.

c. Applied Forces

1. Shock forces were severe enough for the film assemblies to hit or be hit by nearby mechanical assemblies. The force was sufficient to cause paint transfer in two places. Referring to Part #5 of the sketch red paint pigment was imbedded into the pelloid film base. On Part #7 the number "300" is partially legible. (See 20X enlargement). The material imbedded is brown-yellow paint pigment on the base side of the film. The pigment location of "300" and a length of 93 inches indicates this strip was probably an outer convolute.

2. High Pressure, low temperature effects on molecular structure of film base are considered nil for the conditions described. Depressurization tests from 7,000 psi to atmospheric pressure at 3°C after four weeks sustained conditions were made. Dropping from 6,500 - 7,000 psi to ambient pressures in less than two seconds produced no discernable changes in three different tests.

3. A "shattering" force may be defined for this purpose as that force necessary to cause separation of the material in such a period of time that elongation (stretch) does not occur but shearing does. Polymer consultants indicate maximum elapsed time for fracturing must be on the order of milli-seconds. Tests were made to determine if edges could be created by rapidly applied forces which were similar to edge profiles of the recovered film.

Microphotographs were made of cross-sectioned film edges. Different types of edges were generated using repeatable methods. These were then compared to three cross-sections of film edges generated at different points in the film rolls.

Figure 3 depicts four typical edges. The first edge is produced by very rapid snapping of the film (a "fracture"). The "wedge" profile is typical of this type film break and is caused by tnesile shearing. The second edge profile illustrates the fracture and separation occurring on the recovered film. Three physical samples all showed this characteristic cross-section. Third edge was produced by nicking a salvaged film sample with scissors and applying tearing forces by hand. This edge shows relaxation of the film base and recovery shrinkage resulting in a slightly thicker but short edge profile. The fourth picture is the edge profile typical of film slitting.

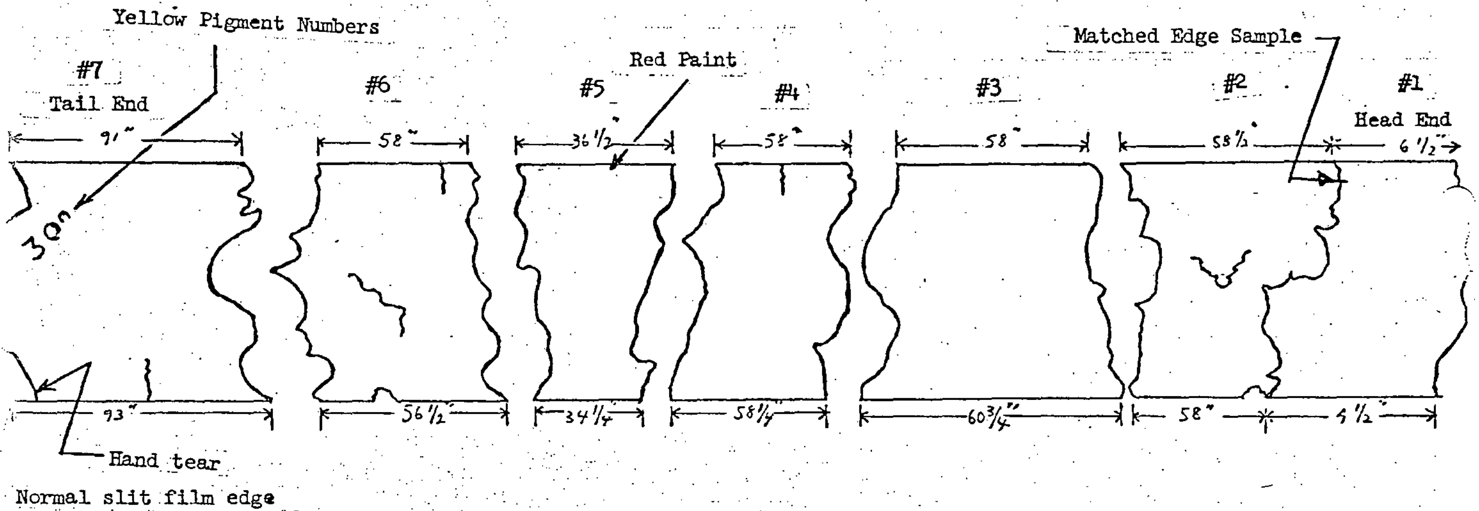
Figure 4 shows opposite edge profiles of a film sample removed at the interface of Parts 1 and 2. The edges were within 1/32 inch of being matched across the full width of the film. Thus an exact fit of the two profiles was not attained due to this displacement but the film profiles are typical of tensile shear failure. The lower photograph is a 40X of the "matched" edges.

By comparing the edge profiles, the "recovered film" most closely matches that caused by sudden tensile shear failure.

CONCLUSIONS:

1. The film stacks structurally failed in tensile shear.
2. Depressurization was not the cause of film fracturing.
3. Transfer of yellow-brown and red paint pigments were caused by film stacks being free to move or impacted by moving objects.
4. The chemical molecular structure of the film support was unchanged due to prolonged exposure to high pressure and low temperature.

Figure No.1



EVALUATIONS

One and two were only sections that edges matched. Film was badly wrinkled and some emulsion was visible. When roll was assembled, all sections overlapped and taped with exception of one and two. Sections totaled 30 feet, 7 inches.

Section #1 One tear 1 1/2 inches from edge
Section #2 Small piece missing near splice
Tear with hole in center of section
Section #3 No tears, badly wrinkled
Section #4 One tear 1 inch from edge
Section #5 Several marks resembling red paint along edge
Section #6 Tear in center area approx. 6" long.
Piece missing along edge 1/4 x 1/4
1 tear near splice from edge 1 inch
Section #7 1 tear from edge 2 inches
A number resembling 300 (yellowish pigment) noted 1 inch from end and 1 3/4 inches from edge of section #7. Each number was .120 x .085 inches.

Refer to above sketch for locations of discrepancies.

Handle via BYEMAN Control System Only

20 X

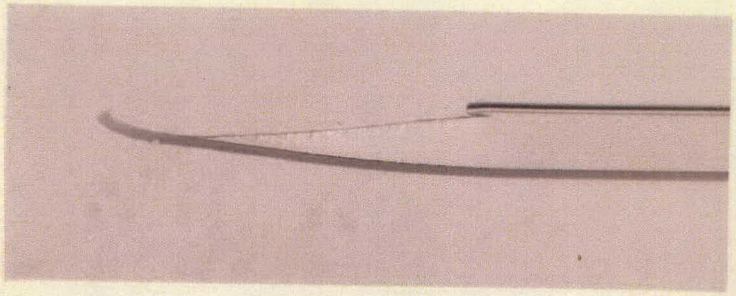
Figure No.2

Handle via BYEMAN Control System Only

Figure No.3

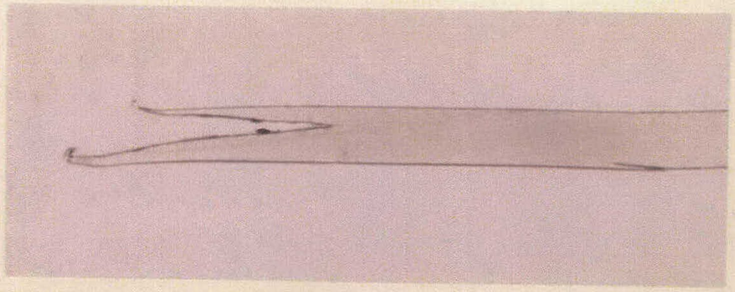
<u>1414 Raw Stock</u>

Cross-section (200X) Produced by "whip snap" shattering.



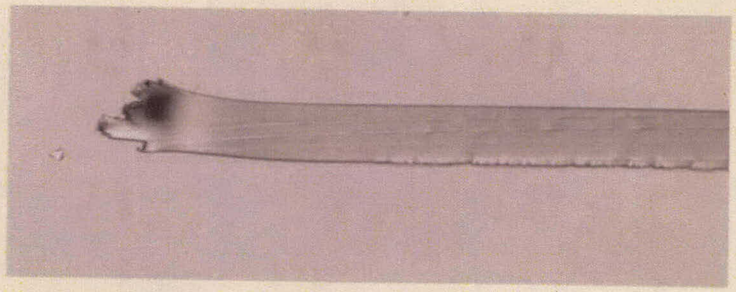
<u>Recovered 1414</u>

Cross-section (200X) Film edge caused in overall recovery operation.



<u>Recovered 1414</u>

Cross-section (200X) Film edge caused by hand tearing.



<u>Recovered 1414</u>

Cross-section (200X)' Film edge normal to manufacturing.

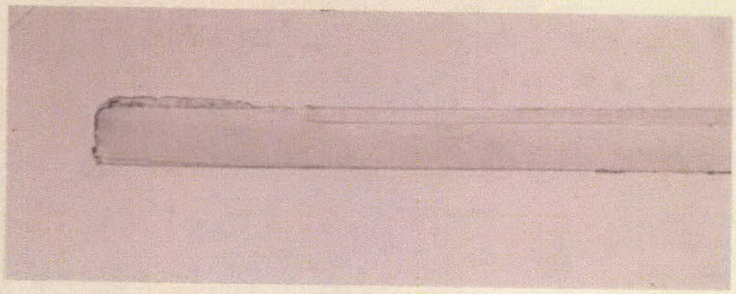
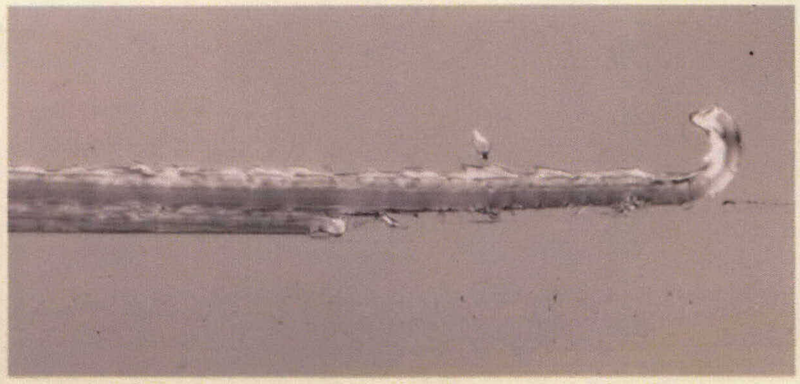


Figure No.4

Adjacent Edges of Separation

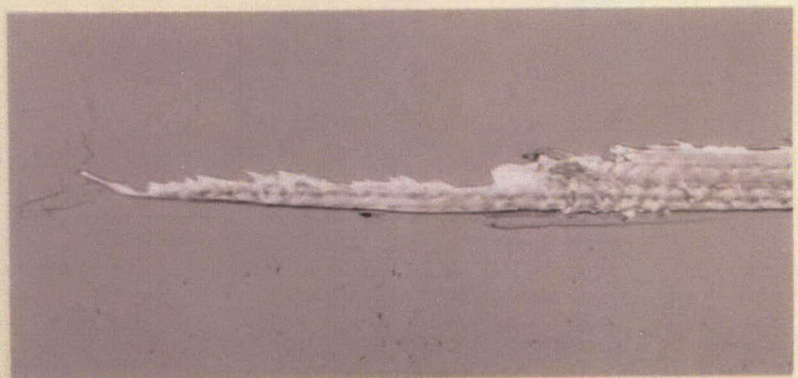
RECOVERED 1414

Cross-section (200X)
Part 2 edge between
Parts 1 and 2



RECOVERED 1414

Cross-section (200X)
Part 1 edge between
Parts 1 and 2



PART 2 MATCHED EDGES OF RECOVERED 1414 PART 1 (40X)