RESTORATION OF ROTTED WOOD WITH A FLEXIBLE PENETRATING RESIN

Establishment of a Restoration Standard for Measuring the Performance Characteristics of Products Used to Effect Restoration of Deteriorated or Rotted Wood

Study of Smith & Co. Professional Version™ Clear Penetrating Epoxy Sealer™ (CPES™) Impregnated into Wood with Varying Degrees of Fungal and Bacterial Rot Formation

Structural Characteristics of Natural and Impregnated Wood

by

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ABSTRACT

Restoration of rotted wood has been standardized by the development of a surrogate standard for rotted wood. This has become necessary because restoration is now a recognized process (since at least 25 years) and a permitted process (latest rule issue, California State Pest Control Board, see Appendix, section 8.6). There are no standards for measuring performance of the various products offered commercially by many companies and promoted for this purpose and, indeed, no such thing as a standard piece of rotted wood to use in repeatable tests.

The concept of a test series was conceived from a study of rotted wood with the aid of a new product developed by Smith & Co. of Richmond, California for restoration of deteriorated wood. From penetration and impregnation studies into wood with varying degrees of fungal and bacterial rot, a testing procedure was developed. The mechanical properties of specimens of treated and untreated wood were tested at varying stress levels up to failure.

Summary

This paper documents a technique to identify two important qualities of restored rotted wood: (1) Microscopic fungal and bacterial rot channels can be thoroughly impregnated, and (2) ***The mechanical qualities of impregnated wood are similar to that of undamaged wood.***

Restoration using epoxy-based products has been used for 30 years. It falls within the scope of processes permitted by the California State Pest Control Board. However, standards to measure the performance of various commercial products have not been available. This is due to the fact that a "standard" piece of rotted wood does not exist and never will exist, since every piece of rotted wood is different.

A testing procedure was developed with the aid of a new impregnating compound developed by Smith & Co. of Richmond, California. Wood exposed to different levels of fungal and bacterial rot was successfully and rapidly impregnated to leave a complete deposition of resin in the damaged, microscopic channels.

A parallel test to define the mechanical properties of treated and untreated wood was developed using a surrogate which closely resembles the mechanical properties of moderately damaged wood. This was based upon the fact that the Smith & Co. product will penetrate undamaged wood a significant distance (approximately 1/4" through end grain, 1/32" through side grain). Though distances and volumes vary according to specie, it was observed that cedar shingles will absorb the Smith & Co. product in approximately the same volume as lightly rotted wood This is the research path which led to the topic of this paper. It was therefore decided to use cedar shingles as a convenient medium to observe mechanical properties of treated wood compared to untreated wood.

A major result of the cedar shingle tests demonstrated that for this particular product, the resin-cellulose bonds have a similar flexibility to that of natural wood. The treated surfaces may be slightly stiffer which adds resistance to bending but they also carry a greater load which results in a net gain in overall bending capability. This was especially true of wood samples that tended to fail under lesser loads. ***The mechanical properties of the treated material were consistently more uniform than untreated wood.*** A test fixture and methodology was designed specifically for this application since no ASTM test is suitable, and since it was desired that anyone be able to easily build their own fixture and conduct their own tests on any other product. The test fixture design is included in an appendix to this paper.

1.0 INTRODUCTION

1.1 History of Smith & Co. products

Smith & Co. developed its initial line of epoxy products in 1972 for use in the recreational marine marketplace to remediate rot damage in wooden boats. The starting market was the San Francisco Bay region, but increasingly Smith & Co. epoxy products have been used over a wide area including specialized outlets as far away as western Europe. The standard consumer grade is marketed under the trademark name Clear Penetrating Epoxy Sealer, also referred to as CPES.

In the early 1980's, founder Steve Smith noticed that local building inspectors were purchasing his product to restore deteriorated wood in their own homes. It was also clear that the product improved the long-term adhesion of varnish, enamel and latex paints to wood. This led to the development of several new products specifically formulated for architectural applications while retaining the formulation principles which made his product uniquely successful in the more severe marine environment. Seasonal modifications to the various formulas were added to maintain consistent performance in weather extremes. As the architectural market began to grow, fillers and compatible coatings were added to the product line. The Professional Version, used in these tests, was developed in 1995. A more detailed discussion of the product is to be found in the Appendix, section 8.6.

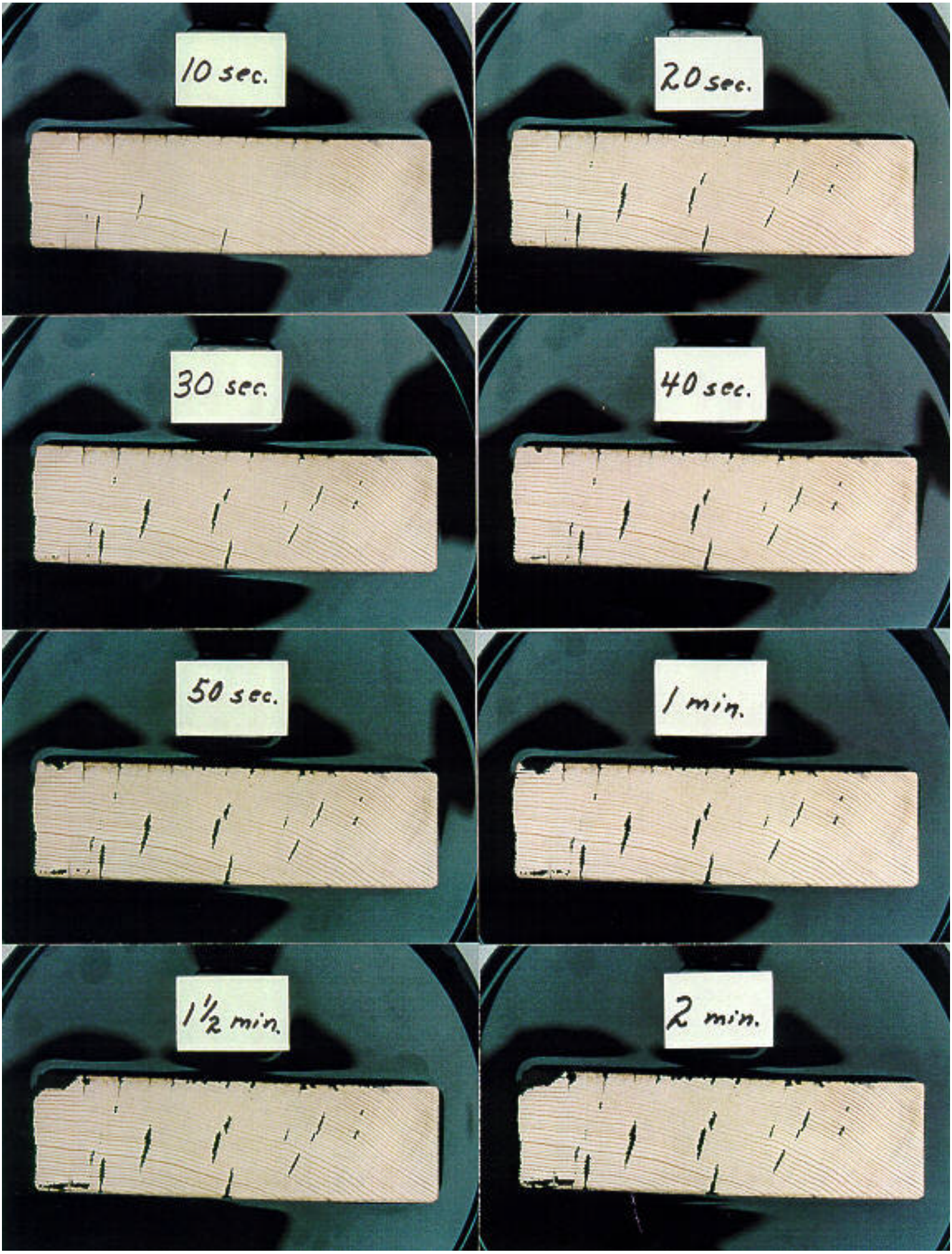
1.2 Summary of tests

This paper describes two test series, one to document penetration of the impregnating resin into several representative classes of rotted wood, and the other to demonstrate the structural properties of treated and untreated wood.

1.3 Test methodology

1.3.1 Epoxy penetration of rotted wood.

Samples of wood that had been exposed to moist conditions over several years were cut into blocks approximately six inches long. The samples were from apparently sound and from severely decayed (in a region) Fir 2 x 6 material, and severely decayed (in a region) Redwood 2 x 6 material. The resulting test blocks were 1-1/2 to 1-5/8 inches high by 5-1/2 inches wide by one inch lengths (1-1/2" x 5-1/2" x 1") exposing end grain in the one inch direction. These blocks were placed in a shallow aluminum pan, end grain up. A dark blue dye was added to the impregnating resin to make the penetration more visible. A quantity of impregnant was poured into the pans, and the blocks were placed in the liquid to 1/4" immersion depth. The blue dyed liquid wicked upward into the samples. The result was documented for sixteen minutes by timed photography. The results were assembled into the photographic sequences on the following pages. As you look at these, notice how the aged but apparently sound fir specimen in the first sequence showed prompt penetration of the impregnant through a small deteriorated region along the top edge, and through a few small cracks. Notice there is no porosity (within the limitations of this test) within most of the area of this evidently sound specimen. Compare with this, the behavior of Fir or Redwood with more severe deterioration, as shown on the following pages.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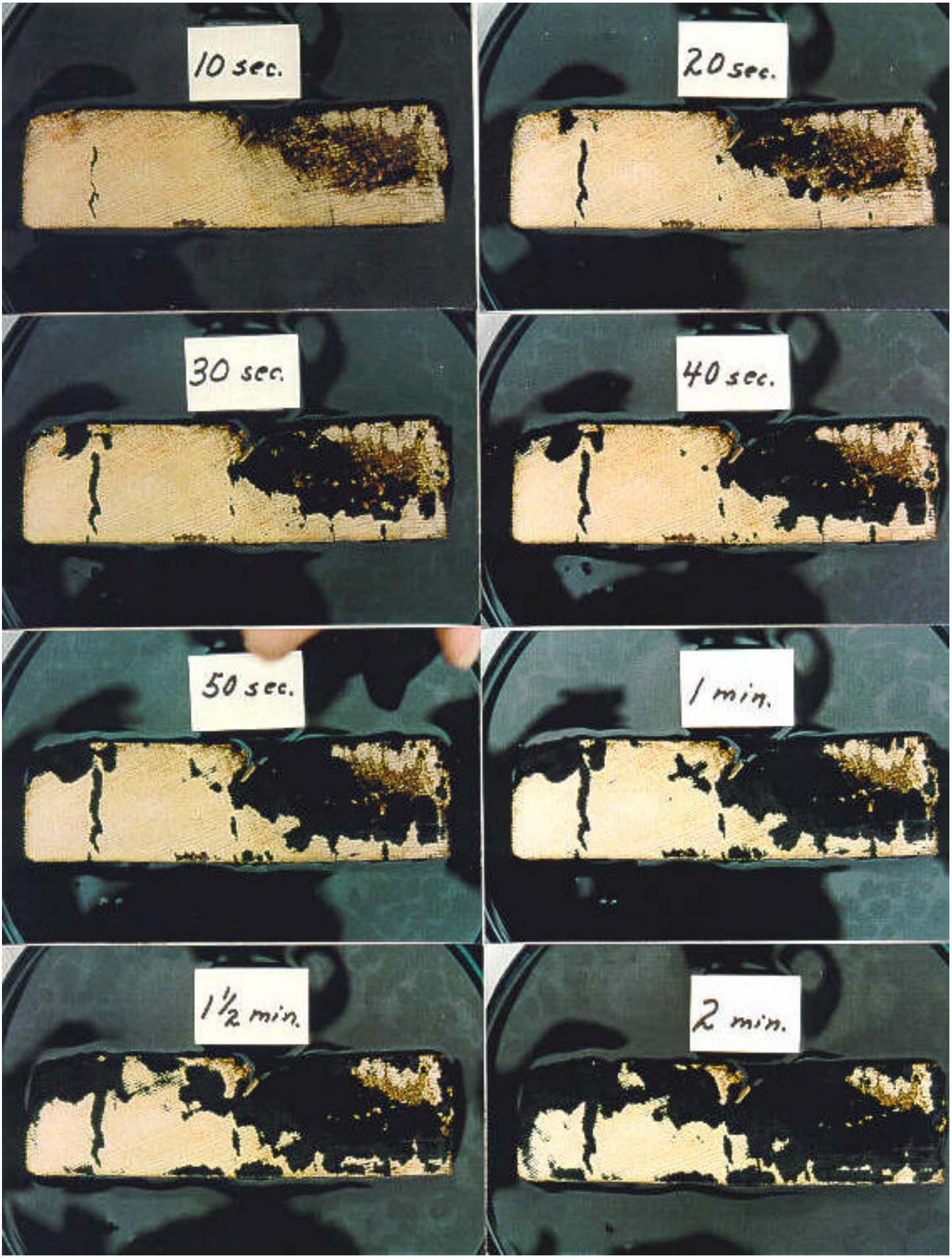
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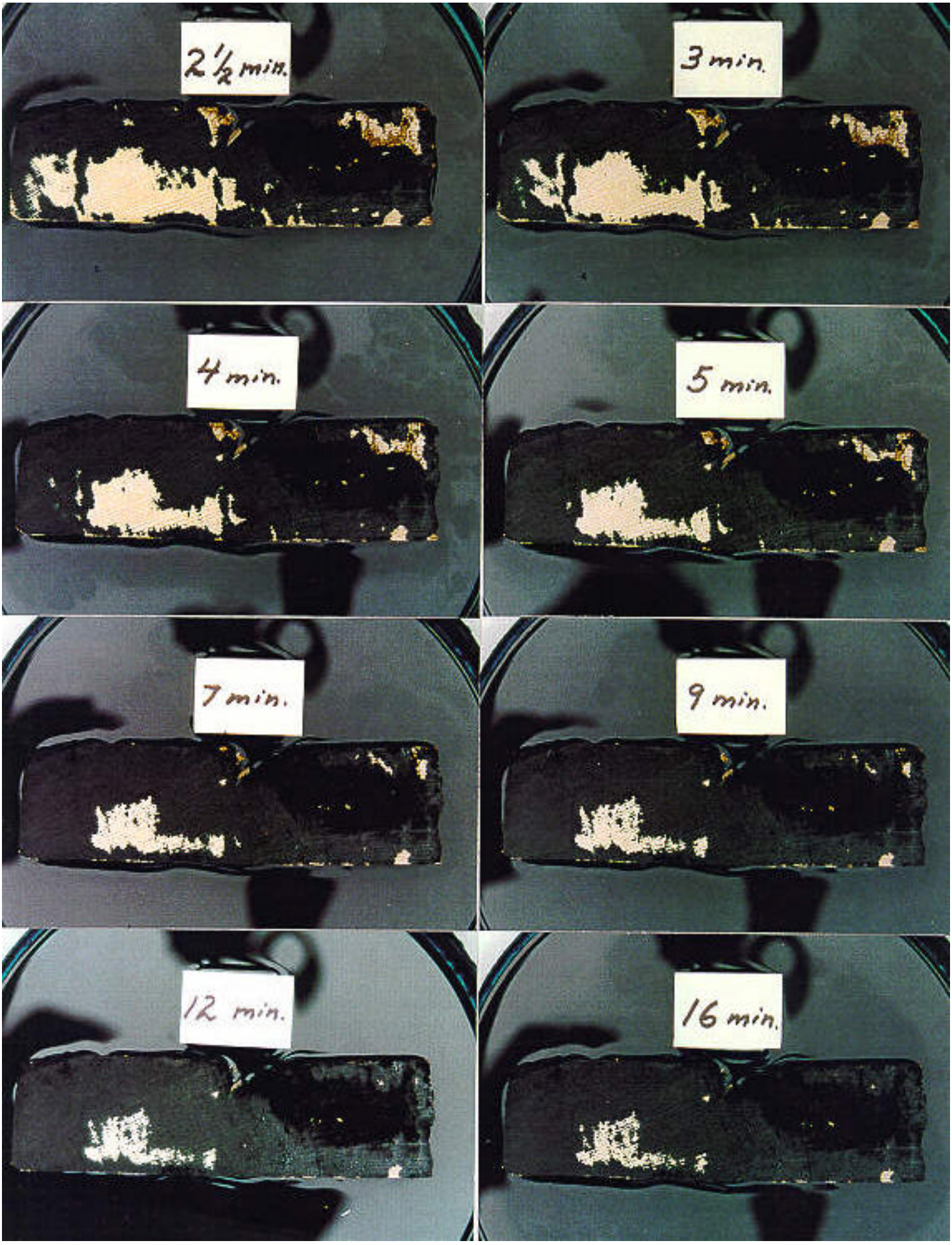
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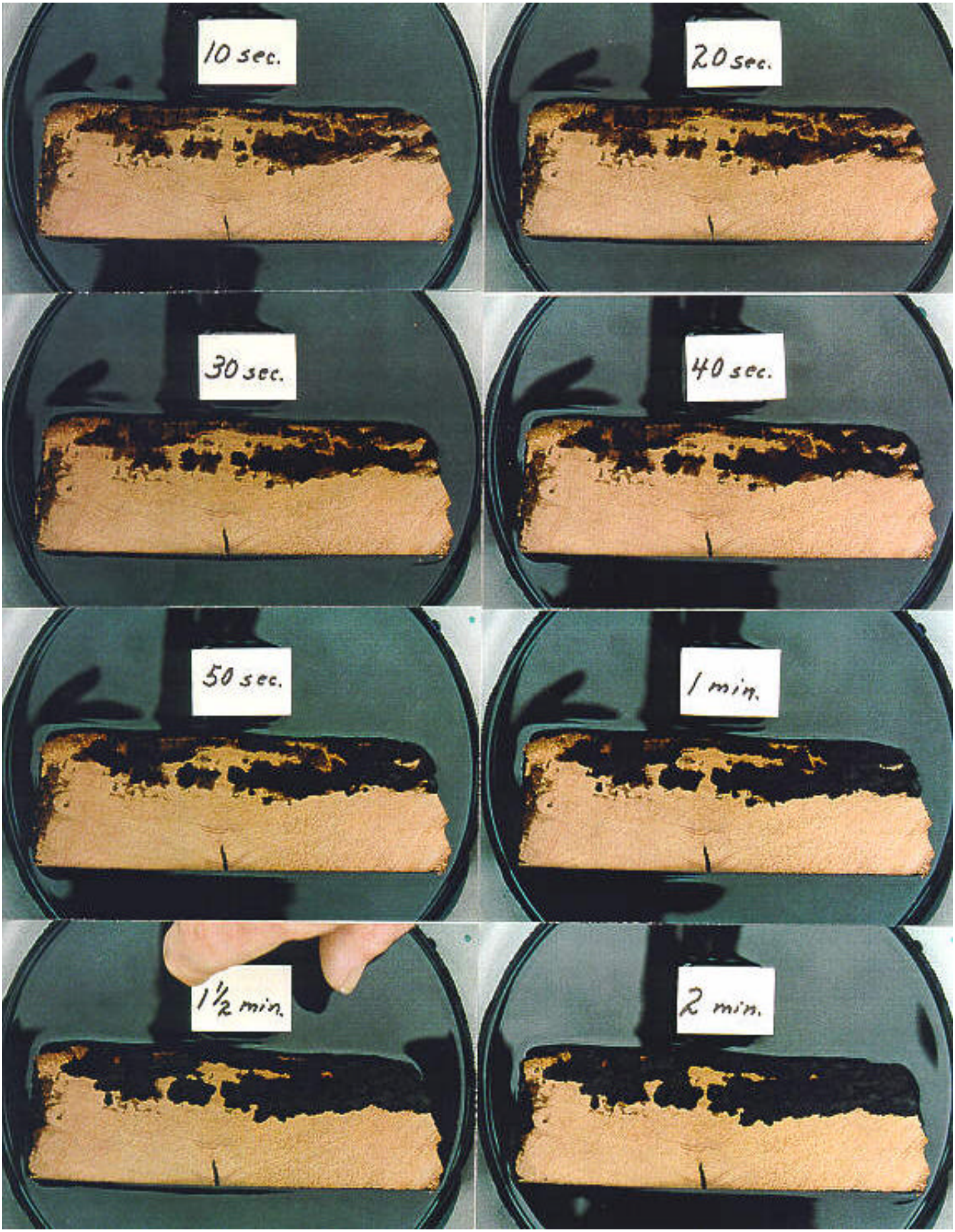
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