

1

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FACSIMILE RECORDING PAPER

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This invention relates to the art of electrical recording media and particularly concerns an electrolytic recording paper.

Recording paper of the electrolytic type is marked by disposing the paper between electrodes consisting of an electropositive metal anode and a metal cathode, and passing an electric current through the paper. The paper is impregnated with an electrolytic solution containing a marking compound. This compound is capable of reacting with ions supplied by the anode to form a colored mark wherever the anode contacts the paper.

Recording paper employed for facsimile communication purposes must meet certain important requirements. The paper must have the ability to produce marks having a density which is a function (preferably linear) of the current passed through the paper. The paper must remain active and resist discoloration when stored for extended periods. Recording marks should be stable when the paper is exposed to ambient conditions of light and air. The active ingredients in the impregnant of the paper must avoid discoloration of or transferring to adjacent sheets of marked or unmarked paper of the same or different type. These requirements, with others, are fully met by the electro-sensitive paper with which the present invention is concerned.

The invention has as a principal objective, the provision of an electrolytic recording paper impregnated with solution containing salicylaldehyde as a marking agent. A further objective is to provide an electrolytically markable recording medium including a high wet-strength porous support impregnated with an aqueous solution of an electrolyte and salicylaldehyde.

A further objective is to provide an electrolytically markable recording medium including a high wet-strength porous paper support impregnated with an aqueous solution of an electrolyte such as potassium nitrate and a sufficient quantity of salicylaldehyde to provide a deep brown mark when an electric current is passed through the paper via a suitable anode and cathode. A further object is to provide a solution for impregnating a porous support to obtain an electrolytically markable recording medium, said solution containing an electrolyte and salicylaldehyde.

Other and further objects and advantages of the invention will become apparent from the following detailed description.

Recording paper impregnated with an aqueous solution of salicylaldehyde and an electrolyte is marked by electrolytic deposits of metal cations in the paper. The cations are obtained from the metal anode which is one of the electrodes employed to apply the marking current to the paper. The cations react with the salicylaldehyde to form a complexion which ranges in color from light to deep brown depending on the density of the applied current.

2

Example

A typical formulation for the impregnant is as follows:

	Grams
5 Salicylaldehyde -----	50
Potassium nitrate -----	400
Water -----	4000

The salicylaldehyde which has a rather limited solubility is dissolved with the electrolyte in the water. White porous paper stock having a high wet-strength is immersed in the solution until the moisture content ranges from 35% to 45% by weight of the impregnated paper. The paper may now be disposed between a pair of electrodes. The electrodes should be resistant to corrosion by the moist impregnant. If an electric potential is applied to the electrodes the paper will be marked electrolytically. Brown marks of various degrees of density will be obtained with certain anodes depending upon the density of the current passing through the paper. Marks of different colors may be obtained by the use of anodes containing silver, iron, copper, nickel, stainless steel, chromium alloys, and other metals. The most satisfying brown marks which provide a good contrast against the white background of the unmarked paper are made with a metal anode made of stainless steel containing chromium to some extent, or with a pure chromium anode.

In the above formulation, the quantity of salicylaldehyde may be varied from a minimum at about 25 grams up to its limit of solubility in the water. The lesser concentrations of salicylaldehyde result in less dense recorded marks. Concentrations of salicylaldehyde greater than 50 grams per 4 liters of water do not produce materially darker marks.

When using the above formulation, the recording paper should contain about 2.5 cubic centimeters of impregnant per square foot of paper. The impregnated paper will weigh about 6.5 grams per square foot. The paper will contain in each square foot about 2.20 grams of water, 0.25 gram of electrolyte, and 0.03 gram of salicylaldehyde. The paper weighs about 4 grams. Thus, the content of the recording medium is approximately as follows:

	Percent
45 Paper -----	61.5
Water -----	34.0
Electrolyte -----	4.0
Marking compound -----	0.5
50 Total -----	100.0

The approximate proportions by weight of the contents of the impregnant in the paper are thus:

	Percent
55 Water -----	89
Electrolyte -----	10
Salicylaldehyde -----	1
60 Total -----	100

If the minimum quantity of 25 grams of salicylaldehyde are used in the above formulation, the approximate proportions by weight of the recording medium will be:

	Percent
65 Paper -----	61.65
Water -----	34.08
Electrolyte -----	4.02
70 Marking compound -----	0.25
Total -----	100.00

3

and the approximate proportions by weight of the contents of the impregnant in the recording medium will be:

	Percent
Water -----	89.4
Electrolyte -----	10.1
Salicylaldoxime -----	0.5
Total -----	100.0

The purpose of the electrolyte is to render the impregnated paper electroconductive. Sufficient electrolyte should be used so that the paper passes about 100 milliamperes of recording current at maximum applied voltage (30 to 70 volts), in a marking area of about .01 of an inch². The optimum resistance will be about 500 ohms.

It was discovered that marks may be obtained having a uniform tonal range from white through sepia to deep brown, even when very low marking currents are used. The use of externally applied heat to fix or intensify the recorded mark is not required for recording paper containing salicylaldoxime as the marking compound.

The half-tone recording characteristic of the impregnated paper is indicated by the following table in which marking current versus optical density and percent light reflectance is listed. Optical density is a measure of the amount of incident white light absorption. Optical density (O. D.) is related to light reflectance as follows:

$$O. D. = \log \frac{100}{\text{percent reflectance}}$$

The data listed was obtained by measurements of recorded marks made on paper impregnated with a formulation as stated above. The paper was marked in a facsimile recorder of the type described in patent to J. V. L. Hogan, No. 2,575,959, at 90 lines (of 8 inch length) per minute. In this recorder a linear anode is disposed to intersect a rotating helical cathode with the recording paper being advanced between the electrodes at uniform speed. The recorded marks were made with both anode and cathode composed of stainless steel.

Current, ma.	Reflectance (R), percent	Optical Density, $\lg \frac{100}{R}$
0 -----	83	0.083
5 -----	56.5	0.250
20 -----	36.5	0.439
30 -----	31.2	0.507
50 -----	24.5	0.612
70 -----	23.0	0.640
80 -----	22.5	0.649
100 -----	20.2	0.696
110 -----	19.0	0.723

It was noted as the data in the table indicates, that as the recording current was increased, the optical density of the recorded marks increased almost logarithmically. It is a known physical phenomenon that to the human eye a uniform logarithmic change in optical density appears as a uniform linear change, thus as the marking current changes linearly the marks in this paper seem to vary linearly in depth of color.

Other oximes which are known reagents for producing complex cations as insoluble colored precipitates were tested for effectiveness as marking compounds in the recorder above mentioned. The impregnants were formulated and the papers were impregnated as described in the example above. The papers were marked with silver, copper, nickel, chromium, stainless steel, and chromium alloy anodes. A stainless steel cathode was used. Poor low density yellow and brown marks were obtained with 5-nitro-salicylaldoxime and 5-chloro-salicylaldoxime. The best marks as to uniformity of color, density of color, and stability were produced at low marking cur-

4

rents and voltages in papers containing only salicylaldoxime as the marking compound with metal anodes of stainless steel containing chromium and with pure chromium anodes. The particular metal used as the cathode is not important in so far as the chemical reaction involved in marking is concerned. Stainless steel cathodes were used with satisfactory results. The cathode material should be non-corrosive in the presence of water solutions contained in the paper and of water vapor released from the paper. The salicylaldoxime employed as the marking compound in the present invention has a melting point of 57° C.-59° C. It has a molecular weight of about 137.13 and its chemical formula is



Various other electrolytes may be used instead of potassium nitrate to render the paper electrosensitive. Materials such as sodium chloride, ammonium nitrate, and the like may be used provided that the electrolyte material does not react adversely with the marking compound and the electrodes.

The use of high wet-strength paper is important so that the paper may be marked at high speed while in a moist condition. A suitable paper of this type will be one containing melamine resins or the like permeating the fibrous structure of the paper. It is important that the resin be of such nature that it does not react with the impregnant to adversely affect the stability thereof or interfere with the marking process.

What is claimed is:

1. An electrically markable recording medium comprising a porous paper support having a high wet-strength impregnated with a solution containing salicylaldoxime as a marking compound, said solution containing substantially by relative weight:

	Parts
Salicylaldoxime -----	50
Electrolyte -----	400
Water -----	4000

said salicylaldoxime being the sole marking compound in said solution.

2. A recording medium comprising a moist, high wet-strength porous paper impregnated with an aqueous solution of an electrolyte and a marking compound, said marking compound being salicylaldoxime, the content by weight of said medium being approximately as follows:

	Percent
Paper -----	61.5
Water -----	34.0
Electrolyte -----	4.0
Marking compound -----	0.5

3. A recording medium adapted for being marked electrolytically between a cathode and an anode containing iron, comprising a white, porous paper sheet having a high wet strength, said paper being impregnated with a solution consisting essentially of an electrolyte and a marking compound, said compound being composed substantially entirely of salicylaldoxime, said solution being capable of reacting with the anode to form marks of a color ranging from white to deep brown when varying electric currents are passed through the paper between the anode and the cathode.

4. An electrically markable recording medium comprising a porous paper support having a high wet-strength, impregnated with an aqueous solution consisting essentially of an electrolyte, and a sufficient quantity of a marking compound to provide a deep brown mark when an electric current is applied to the paper via a pair of electrodes consisting of an anode and a cathode, said anode being composed of a metal, said compound being composed substantially entirely of salicylaldoxime.

5. An electrolytically markable recording medium,

2,864,748

5

comprising a porous paper support impregnated with an aqueous solution consisting essentially of an electrolyte and a marking compound composed substantially entirely of salicylaldoxime, the salicylaldoxime being present in at least 0.5% by weight of the solution.

5

6

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