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PRINTING INK AND METHOD OF USING
SAME

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This invention relates to methods for determining the amount of ink material required for a given number of printed impressions, or "mileage" characteristics of ink materials, and also to ink materials suitable for such determinations.

It is an object of the present invention to provide a method for determining the amount of a given ink or coating material which is required to produce a desired coverage upon a selected base material.

Another object of the present invention is to provide a method for determining the amount of a given ink required to make a given number of printed impressions in a commercial printing operation, i. e., the mileage characteristics of the ink.

Another object of this invention is to provide a method for evaluating the printability of ink materials and of paper stocks under various commercial printing conditions.

Another object of the present invention is to provide a treated ink material which is suitable for use in determining the amount of ink material required to make printed impressions in a particular printing operation.

Other objects of the invention will be apparent from the description and appended claims.

In the graphic arts industry, one of the important requirements necessary to determine the cost of a printing operation is a satisfactory method of estimating the amount of ink material which will be required in a particular printing job. And this is especially important with high speed presses of the type which are employed to print present day newspapers, publications and the like. With such presses, the amount of ink material used per unit time of operation is relatively large. An estimate of the total amount of ink which will be required for the printing operation is necessary to prevent running out of ink material before the printing operation is finished, with consequent shutting down of the presses and loss of time and money until additional ink is obtained, and to avoid the opposite danger of having a large surplus of ink material left over at the end of a printing operation, the cost of which generally must be added to the printing operation, even though the ink is not employed for that job. It is desirable that this estimate be accurately and readily performed, and that it involve a minimum of time and expense.

By the present invention we have provided methods of estimating with accuracy and precision, in advance of a particular printing operation, the amount of ink material that will be re-

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quired for that particular printing operation. As a result of the present invention, the printer is able to present to his customer an accurate estimate of the amount of materials, including ink, required to complete satisfactorily a printing operation under consideration.

In the present invention we include a substance in printing ink which may be readily detected quantitatively in printed impressions. This substance is distributed uniformly through the ink, in an amount which will not change the printing characteristics of the ink, and by evaluating the amount of such substance in ink applied to a unit area of printed surface, the amount of such ink required to print any multiple of such unit area may be determined accurately. This may be satisfactorily accomplished by making a few test prints, and then by determining the average amount of such substance present in these test prints, the total amount of ink required to print upon a desired area of surface of any multiple of the same or substantially the same printed area, or unit areas requiring substantially the same amount of ink, of the same or comparable characteristics, may be determined with adequate accuracy. The test prints should be made upon the same or a comparable kind of surface as that which is to be used in the printing operation under consideration, so that conditions substantially comparable, in amount of ink used per unit area, to the subsequent printing operation will be secured.

Accurate and satisfactory results may be obtained by dissolving or completely dispersing a radioactive substance in a sample of the ink to be used in the actual printing operation. A minute quantity of radioactive substance will be sufficient if means is used for measuring the resulting radioactivity, which means is sufficiently responsive thereto to give an accurate quantitative determination of the amount of radioactivity in a unit printed area. Successful practical results have been secured by dissolving or dispersing a radioactive substance in a liquid which is miscible with the liquid phase of the ink, and then adding this solution or dispersion to the ink before the grinding operation.

The ink containing such dissolved or completely dispersed radioactive substance then is utilized in a proof printing operation of the kind normally effected in the ink and printing industry to determine ink and paper performance, and some test prints made on the paper stock or other base to be imprinted. The prints are made in such manner that they will have, as nearly as

practicably possible, the correct film thickness for the best possible representation of the subject matter to be imprinted and likewise the correct film thickness to be secured in the final and more lengthy printing operation. Predetermined areas of such test prints then are scanned to determine the amount of radioactivity present. From this amount, and the area of the printed surface which is scanned, the amount of ink which will cover any multiple of the unit printed area thus scanned with impressions requiring ink in amounts substantially comparable to such unit area can then be calculated.

To accomplish scanning of the printed material to obtain an accurate measurement of the radioactive substance present, an apparatus such as the Geiger-Müller counter satisfactorily is employed. This apparatus is adapted so that it will give a count of the amount of activity of the radioactive substance. The apparatus consists essentially of a high voltage source which operates a specially designed discharge tube (called the counter), an amplifying and electronic scaling circuit and a mechanical recorder. High-energy electrons from the radioactive substance penetrate a thin mica window and produce a momentary discharge in the counter tube which is amplified and transmitted by the scaling circuit to the mechanical recorder.

Representative of an ink material which satisfactorily can be utilized according to the present invention is the following illustrative example:

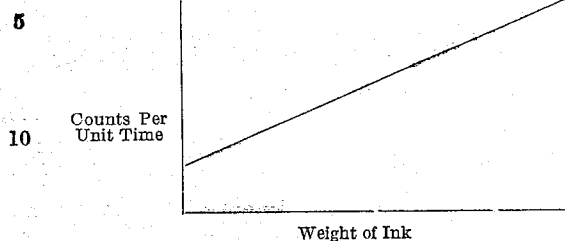
EXAMPLE 1

Corn protein-----	6.6
Diethylene glycol soluble rosin-modified phenol formaldehyde resin-----	14.6
Diethylene glycol-----	55.9
Tracer material (a solution or dispersion of a radioactive substance)-----	3.1
Carbon black-----	19.8
	100.0

In practical operation, according to the present invention, a calibration curve first is set up to be utilized in connection with actual testing operations. To obtain a calibration curve, measurements are secured by means of the Geiger-Müller counter of the background of cosmic radiation with the window of the counter in position. This position of the window then is maintained constant throughout any series of standardization and testing procedures, since the accuracy of the count of radioactive substance given by such apparatus depends upon the geometry of the setup. A reading then is secured for the radioactive substance present in a known area of a standard printed surface, obtained by printing upon such surface with an ink such as that described in Example 1, where the weight of the ink film on such area is likewise known.

For standardization purposes, such weight determination can be made satisfactorily by a gravimetric method. A suitable gravimetric method consists of inking a printing plate, weighing the inked plate, making an impression, weighing the plate again, and determining the ink used in printing by difference. In order to give the required accuracy in weighing, the printing plate should consist of a very thin sheet of copper held firmly to a heavy metal base during the printing operation. From such readings a curve can be drawn relating the count of radioactive substance to weight of ink per unit area.

Such calibration curves, indicating the relationship above described, generally can be represented in the following manner:



The point where the curve crosses the ordinate represents the background of cosmic radiation at the time and under the conditions of standardization and testing. The absorption of high-energy electrons in the ink film itself is negligible for film thicknesses encountered in the printing process so a straight line can be drawn through the two points determined by the background radiation and reading on the standard print. Because of the decay of the radioactive substance the calibration curve changes with time. It is necessary, therefore, to obtain a reading for the standard print at the time the testing operations are to be performed to establish a calibration curve which will be correct at that time and for those conditions. It will be evident that the radioactive substance decays at the same rate in the treated ink material and in printed impressions made from the treated ink material. Hence the standard print can be made with a known amount of the treated ink, as described above, whenever convenient prior to testing operations with the same treated ink, and the radioactivity of the standard print can then be measured to establish the calibration curve at the time the radioactivities of test impressions made with the same treated ink are measured.

Prints then can be made with an ink such as that described in Example 1 upon various base stocks or under various printing conditions such as will be encountered in commercial printing operations and counts made of the amount of radioactivity of an area of the same dimensions as that utilized in obtaining the calibration curve. From the count obtained, the weight of ink per unit area of paper is readily obtained by use of the calibration curve.

Readings obtained with apparatus such as the Geiger-Müller counter are obtained for a definite period of time, for example, one minute, and are described in discharges or counts. Other times of measurement or units of designation may be employed.

The ink of Example 1 is of the type adaptable for use in the so-called steam or water setting printing process wherein the setting of the imprinted ink is secured by treatment of the printed material with water, for example, as steam or vapor. A solution of radioactive tracer material which has been employed in this illustrative ink formulation is a solution of radioactive arsenic dissolved as NH_4AsO_2 in water; the amount of arsenic present being of the order of 1 mg. per ml. of water. However, a relatively large number of radioactive substances are available today at reasonable cost and other radioactive substances may be used. The radioactive substance should preferably have a reasonably long half-life time so that tests may be conducted with the same treated ink over a period of a few weeks. The radioactive substance should pref-

erably be miscible or at least partially soluble in the liquid phase of the ink to obtain uniform distribution throughout the ink. The amount of radioactivity in the treated ink is not critical, as the Geiger-Müller counter used to measure the amount of radioactivity is sensitive over an extremely wide range, and can be used to measure amounts of radioactivity ranging from minute quantities up to quantities far beyond the amounts ordinarily utilized in practicing this invention.

Another printing process is illustrated by the so-called heat-setting printing operation. In this printing operation a web of material is led through the printing press and is imprinted with an ink containing a binder material dissolved or dispersed in a solvent whose evaporation characteristics are such that no objectionable evaporation of the solvent occurs before the printing process, but upon heating of the imprinted web, solvent is removed therefrom by evaporation to leave a relatively non-offsetting and non-smudging print. Such printing process, and the inks therefor, are employed to a considerable extent in the preparation of present day magazines where speed in the preparation of the completed printed magazine is desired. Illustrative of an ink, useful in such process, and which can be utilized according to the present invention, is the following:

EXAMPLE 2

Vehicle A-----	58.4
Vehicle B-----	20.36
Ink solvent-----	2.57
Talc-----	1.61
Lamp black pigment-----	1.93
Carbon black pigment-----	15.11
	99.98

To this is added, in accordance with the present invention, and to determine the mileage characteristics of the ink material, a radioactive phosphorus pentachloride dispersed in a mixture of Vehicles A and B in the proportions in which they are used in the ink material.

It is not necessary to know exactly the weight of the radioactive substance which is dispersed, since, as above described, the activity will be determined in setting up a calibration curve and this activity related to the amount of ink per unit area of surface. Also, in subsequent testing operations, it is the radioactivity of the imprinted ink material which is determined.

The formulas of the vehicles utilized in the ink in Example 2 are:

Vehicle A

Limed rosin-----	28.1
Rosin - modified glycerol - maleic anhydride resin-----	26.1
Petroleum type solvent-----	45.8
	100.0

Vehicle B

Limed rosin-----	41.5
Gilsonite-----	10.2
Petroleum type solvent-----	48.3
	100.0

These vehicles are prepared in the usual manner well known to those skilled in the industry, as for example by heating the mixture until all of the solid materials are dispersed or dissolved therein.

Illustrative of an ink material designed for utilization on commercial press equipment, and in which the setting of the ink material is secured by oxidation and polymerization of the vehicle components, is the following:

EXAMPLE 3

Red pigment-----	37.25
Bodied linseed varnish-----	57.16
Cobalt drier-----	2.79
Paste drier-----	2.79
	99.99

For utilization, according to the present invention, there is added to this ink a bodied linseed varnish containing radioactive phosphorus pentachloride.

There is provided, therefore, by the present invention, a method for determining mileage characteristics of ink materials which is simple in operation and by which determinations can be made with relatively great speed and accuracy. There are also other ink and printing characteristics which can be evaluated by utilization of the methods herein described, for example, to determine the relationship between the amount of ink on a given printed area and the quality of the print. This relationship is useful in evaluating the printability characteristics of inks and of paper under various commercial printing conditions. Determinations of this type have been made in which various amounts of the same ink were used to print on several different paper stocks. The amount of ink was determined in accordance with this invention, the brightness was calculated from spectrophotometric reflection curves, and the print quality was judged subjectively from half-tone prints. The brightness of a black print of satisfactory print quality varied between 5.0% and 7.5%, 100% being the brightness of a freshly smoked magnesium oxide surface. In the tests conducted a good correlation was found between the print quality of the different paper stocks and the amount of ink required to obtain the same brightness range of 5.0% to 7.5% for each paper stock. Similar determinations can be used in evaluating the printability of different inks on a given paper stock.

While the methods and articles herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise methods and articles, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. The process which comprises incorporating a radioactive substance in a non-radioactive printing ink, in amount insufficient to change the printing characteristics of said ink, printing with such ink upon a surface, and subsequently determining the radioactivity of the imprinted surface.
2. The process which comprises uniformly distributing, in amount insufficient to change the printing characteristics of a printing ink, a radioactive arsenic substance through a non-radioactive printing ink comprising a vehicle, which comprises a binder component immiscible in water, dissolved or dispersed in a solvent component miscible with water, printing with such ink upon a base surface, and subsequently determining the radioactivity of the imprinted base.
3. The process which comprises uniformly distributing, in amount insufficient to change the

printing characteristics of a printing ink, a radioactive phosphorus substance in a non-radioactive printing ink comprising a vehicle, which vehicle comprises a binder component dissolved or dispersed in a solvent component, said solvent component having evaporation characteristics such that it is substantially press stable at normal press temperatures and which evaporates rapidly upon heating of the imprinted web, printing with such vehicle upon a base surface, and subsequently determining the radioactivity of the imprinted base.

4. The process which comprises uniformly distributing, in amount insufficient to change the printing characteristics of a printing ink, a radioactive phosphorus substance in a non-radioactive printing ink comprising a bodied drying oil varnish, printing with such ink upon a base surface, and subsequently determining the radioactivity of the imprinted base.

5. The method of determining mileage characteristics of coating materials which comprises incorporating a radioactive substance in a coating material, in amount insufficient to affect the coating characteristics of said material, applying said radioactive coating material to a base in a desired film thickness, determining the radioactivity of a known area of the coated base, and comparing the determined radioactivity with that of a base material of the same or similar characteristics coated with said radioactive coating material, and for which the radioactivity and weight of coating per unit area have been determined.

6. The method of determining mileage characteristics of coating materials which comprises incorporating radioactive arsenic substance in a coating material, in amount insufficient to affect the coating characteristics of said material, said coating material comprising a water immiscible binder component dissolved or dispersed in a water miscible solvent component, applying said radioactive coating material to a base in the desired film thickness, determining the radioactivity of a known area of the coated base, and comparing the determined radioactivity with that of the base material of the same or similar characteristics, coated with said radioactive coating material, and for which the radioactivity and weight of coating per unit area have been determined.

7. The method of determining mileage char-

acteristics of coating materials which comprises incorporating radioactive phosphorus substance in a coating material, in amount insufficient to affect the coating characteristics of said material, said coating material comprising a binder component dissolved or dispersed in a solvent component, said solvent component having evaporation characteristics such that it is adequately stable at normal temperatures and evaporates from a coated film upon application of heat, applying said radioactive coating material to a base in a desired film thickness, determining the radioactivity of a known area of the coated base, and comparing the determined radioactivity with that of a base material of the same or similar characteristics coated with said radioactive coating material and for which the radioactivity and weight of coating per unit area have been determined.

8. The method of determining mileage characteristics of coating materials which comprises incorporating a radioactive substance in a coating material, in amount insufficient to affect the coating characteristics of said material, said coating material comprising a drying oil varnish, applying said radioactive coating material to a base in a desired film thickness, determining the radioactivity of a known area of the coated base, and comparing the determined radioactivity with that of a base material of the same or similar characteristics coated with said radioactive coating material and for which the radioactivity and weight of coating per unit area have been determined.

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