

THE EFFECT OF SODIUM ORTHO PHENYL PHENATE ON VISCOSITY, JELLY STRENGTH, AND ADHESIVE STRENGTH OF GLUE¹

I. F. FLEISCHER and R. J. HARTMAN, Indiana University

The use of sodium ortho phenyl phenate as a glue preservative was introduced about four years ago by the Dow Chemical Company, Midland, Michigan. In this investigation the effect of the addition of various amounts of sodium ortho phenyl phenate to glues on viscosity, jelly strength, and adhesive strength was studied.

Experimental

Materials.—Two different grades of animal glue were furnished by the Conrad-Kammerer Glue Company, Inc., New Albany, Indiana. Their method of preparing the glues in their plant was as follows: The raw material was first soaked in a concentrated solution of lime, washed free of the lime, treated with sulphurous acid, washed again, and then subjected to hot water, which dissolved all the gelatinous substance. Excess water was evaporated from the solution of glue and at this point portions were withdrawn, jelled, dried and pulverized, samples of glue being thus obtained without having had any preservative added.

The sodium ortho phenyl phenate was obtained from the Dow Chemical Company, Midland, Michigan. In their bulletin "Glue Preservation" (Special Development Bull. 14, Dow Chemical Company. 1931) the following chemical and physical properties of sodium ortho phenyl phenate are given: chemical formula— $\text{NaCO}_2\text{H}_2\text{C}_6\text{H}_5 \cdot 3\text{H}_2\text{O}$, melting point—78° C., molecular weight—246, color—white, form—needle crystals, solubility in water—40% at room temperature.

In this bulletin it is cited that this compound is a glue preservative and that it increases the tensile strength as measured by the "maple block test".

Apparatus and Method of Procedure.—A series of samples was prepared in duplicate by accurately weighing fifteen grams of the same grade of commercial dry glue. To each of these samples was added varying percentages of sodium ortho phenyl phenate by dry weight of glue and 105 c.c. of distilled water at approximately 15° C. The samples were permitted to soak over night at a temperature of approximately 15° C. and then placed in a melting bath and brought to 62° C. The time required to bring the samples up to this temperature did not exceed 15 minutes. Having attained the required temperature there was no delay in transferring the glue solution to the viscosimeter. The viscosities were determined at 60° C.

The same samples were allowed to jell at 10° C. for 17 hours. The determination of the jelly strength of the samples was made with a Bloom gelometer (J. Ind. Eng. Chem., analytical Ed. 2:348. 1930), adjusted to give a 4 mm. depression. Results are expressed in the nearest whole gram required to produce the 3 mm. depression. The tests reported were determined at the same time and under the same conditions.

¹The tensile strengths of the glues were determined at Purdue University, under the direction of Professors Hatt and Hollister.

Results.—Table I shows the effect of the addition of varying percentages by dry weight of sodium ortho phenyl phenate on viscosity and jelly strength of a high grade glue.

TABLE I
pH, Viscosity, and Jelly Strength as Affected by Sodium Ortho
Phenyl Phenate

Sample No.	% Sodium Ortho Phenyl Phenate by Dry Weight of Glue	pH (Colorimetric)	Viscosity in Millipoise	Jelly Strength (grams)
1	.0	6.40	78.5	262
2	.2	6.55	79.0	267
3	.4	6.60	79.5	257
4	.5	6.75	80.0	260
5	.8	6.80	78.5	256
6	1.0	6.95	77.5	252

None of the samples in Table I contained zinc sulphate.

It was found that the addition of sodium ortho phenyl phenate did not noticeably increase the foam of the glue solutions.

Increasing the percentage of sodium ortho phenyl phenate caused the glue solutions which were acid originally to become less acid, as would be expected. As the percentage of sodium ortho phenyl phenate was increased to 1% the glue solutions became nearly neutral, as indicated in Table I. Glue solutions containing 3% or more (not included in the above table) were very slightly alkaline.

Figure 1 shows the curve obtained by plotting the viscosity against the percentage of sodium ortho phenyl phenate by dry weight of glue.

In order to determine the effect of varying amounts of sodium ortho phenyl phenate on the adhesive strength of low and high grade glues, 33⅓% glue solutions were prepared. To these were added varying percentages of sodium ortho phenyl phenate by dry weight of glue. The mixtures were heated on a water bath until homogeneity was reached. This required approximately one and one-half hours.

Air dried maple blocks (2"x2"x11"), dried in an electric oven at 100° F. for a period of 48 hours before each test, were used in determining the adhesive strengths. A film of this hot glue was applied to the ends of two maple blocks. The blocks were then mounted in an upright position and pressed together firmly with the hands. The specimens were allowed to dry in this position at room temperature for a period of

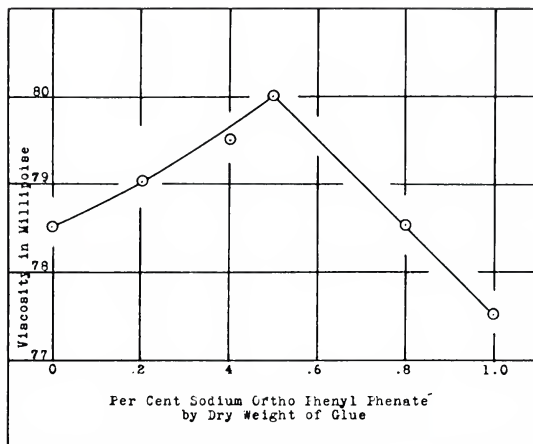


FIG. 1

ninety-six hours. At the end of this drying period, the strength tests were conducted. In each case three specimens were made for each glue. This was considered necessary since the fiber structure of the blocks varies considerably. After testing the specimens, a thin section of the glued ends of each block was cut off in a miter box with a saw and the same blocks used in the next two duplicate tests of the same glue sample.

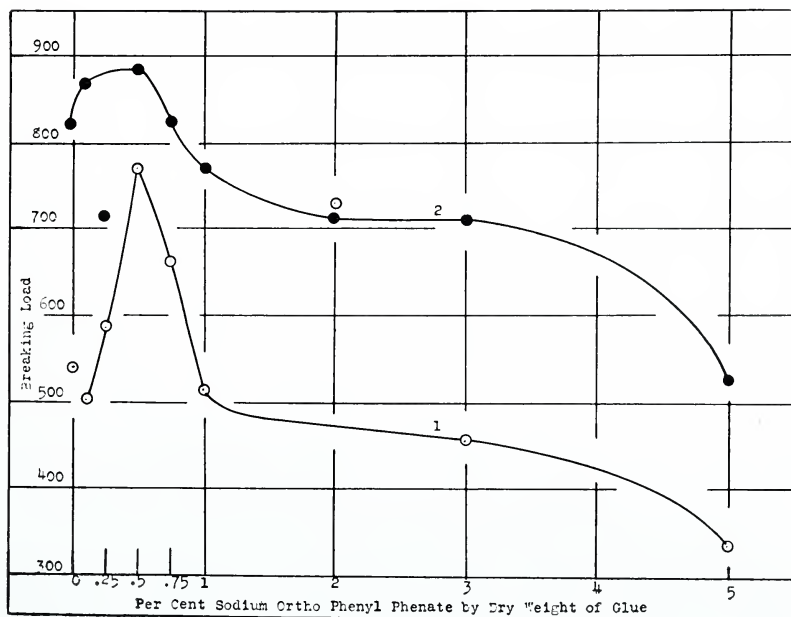


FIG. 2.

TABLE II

Adhesive Strength of Glue as Affected by Sodium Ortho Phenyl Phenate

% Sodium Ortho Phenyl Phenate by Dry Weight	Low Grade Glue		High Grade Glue	
	Specimen Number	Breaking Load (Lbs.)	Specimen Number	Breaking Load (Lbs.)
0.00.....	1a	605	10a	870
0.00.....	1b	585	10b	800
0.00.....	1c	425	10c	790
		Av. 538		Av. 820
0.10.....	2a	255	11a	935
0.10.....	2b	540	11b	885
0.10.....	2c	460	11c	780
		Av.(2b,2c) 500		Av. 866
0.25.....	3a	550	12a	780
0.25.....	3b	765	12b	720
0.25.....	3c	435	12c	640
		Av. 583		Av. 713
0.50.....	4a	610	13a	900
0.50.....	4b	795	13b	900
0.50.....	4c	900	13c	850
		Av. 768		Av. 883
0.75.....	5a	525	14a	730
0.75.....	5b	610	14b	845
0.75.....	5c	850	14c	820
		Av. 662		Av. 798
1.00.....	6a	580	15a	895
1.00.....	6b	505	15b	745
1.00.....	6c	450	15c	665
		Av. 512		Av. 768
2.00.....	7a	685	16a	650
2.00.....	7b	785	16b	645
2.00.....	7c	1055	16c	840
		Av.(7a,7b) 735		Av. 712
3.00.....	8a	430	17a	835
3.00.....	8b	370	17b	740
3.00.....	8c	560	17c	685
		Av. 453		Av.(17b,17c) 71
5.00.....	9a	310	18a	530
5.00.....	9b	320	18b	550
5.00.....	9c	375	18c	495
		Av. 335		Av. 525

All strength tests were conducted in a standard (30,000 lbs.) Universal testing machine, sensitive to 5 pounds.

The test specimens were mounted horizontally in the machine on standard knife-edge bearings, spaced 18 inches apart. Suitable roller bearings and plates were provided between the knife-edges and the wood test blocks. The loads were applied at mid span through the medium of a wood block and a curved plate.

Figure 2 shows the graphs obtained by plotting the data in Table II. Curve 1 is plotted from the data obtained with the low grade glue and curve 2 from the data obtained with the high grade glue. It is evident from Figure 1 that additions of sodium ortho phenyl phenate up to 0.5% by dry weight of glue increase the adhesive strength of the glues, the low grade glue being aided more than the high grade glue.

Discussion and Conclusion

From Table I it is noted that the addition of sodium ortho phenyl phenate increases the pH. This might account in part for the corresponding changes in the various physical properties of glue. It is interesting to find that this compound claimed by the Dow Company to be a preservative seems to improve the physical properties of a glue as well.

The addition of 0.25% to 0.50% sodium ortho phenyl phenate to glue tends to increase the jelly strength and to lessen acidity. It prevents deterioration, does not cause increased foam, and increases the adhesive strength as herein measured.