# Traffic Paint Development in California

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● IT IS common knowledge that evolution plays an important role in nearly all of our practices in an industrial economy. That this premise is valid in the realm of traffic-paint manufacture and use may not be so well known, but it is abundantly true. Most of us will remember the introduction of cross-walk markings in towns with an occasional designation of parking limits near a driveway. We saw this marking extend to curves on the main highways to designate the location of the lanes of travel. We watched those lines grow into the open highway and develop into a two-color scheme and double-line system in strategic areas. Reflectorized lines soon followed, then the broken line, in some states, as an economical measure. Machines for applying the lines kept pace with this evolution as traffic demands increased. The lacquers we have been using have not maintained the rate of advancement noted in the mechanical aspects of its application.

Today in California we are not sure of the exact formulations used in the early traffic lines, but a good guess would suggest gloss oils or very short oil varnishes with the white pigments available. Drying time and durability were not so important in those days as now. Variations of the above-mentioned formulation led to the eventual development of the California formula by G. H. P. Lichthardt, which was used so successfully for many years in this state and several others. This formulation, for California, is still one of the best we have been able to devise. Oddly enough, most other states do not share our satisfaction. Experimental work in the East has shown failure of this paint within a month. Of course, this formulation gained its reputation during a time when traffic volume was merely a fraction of that of today. Time was not such a vital factor under those conditions. Even under present conditions, however, the old California formula using Manila D. B. B. resin and chinawood oil is in great favor among our paint crews. That their faith is often justified is apparent from Figure 1. The traffic line shown here was of the old California formula. It had been exposed on asphalt for over 10 months at the time the photograph was made. Summer traffic was about 6,000 vehicles per day with a probable decrease of 20 percent in winter.

The performance of this paint on concrete has not matched that observed on asphalt. Figure 2 will illustrate this to some extent. The foreground in this photograph is asphalt, the background concrete. The striping is the same as that shown in Figure 1, except that this was 7 months exposed when photographed. Traffic here was about 12,000 vehicles daily. The background striping shows failure by chipping. Although the relatively short life of this paint on portland concrete has been known for several years, it might have remained our mainstay had not national shortages of vital components driven us into other formulations.

Preliminary experimentation with numerous formulations on transverse traffic lines led to selection of a few of them for large-scale trial. An abrasion apparatus, based on a design developed by the staff of the Los Angeles City Bureau of Standards was acquired some time later. This machine consists of a 3/4-in. plate glass, 4 ft. in diameter, which acts as a track for anchorage of traffic stripes. The stripes, 0.015 in. thick, are drawn with a doctor's blade and allowed to cure for 72 hr. Weighted rubber-tired wheels set at a 2-deg. bias are then driven over the lines for a definite number of passes, dry. This is followed by a similar treat-

Figure 1.

Figure 2.

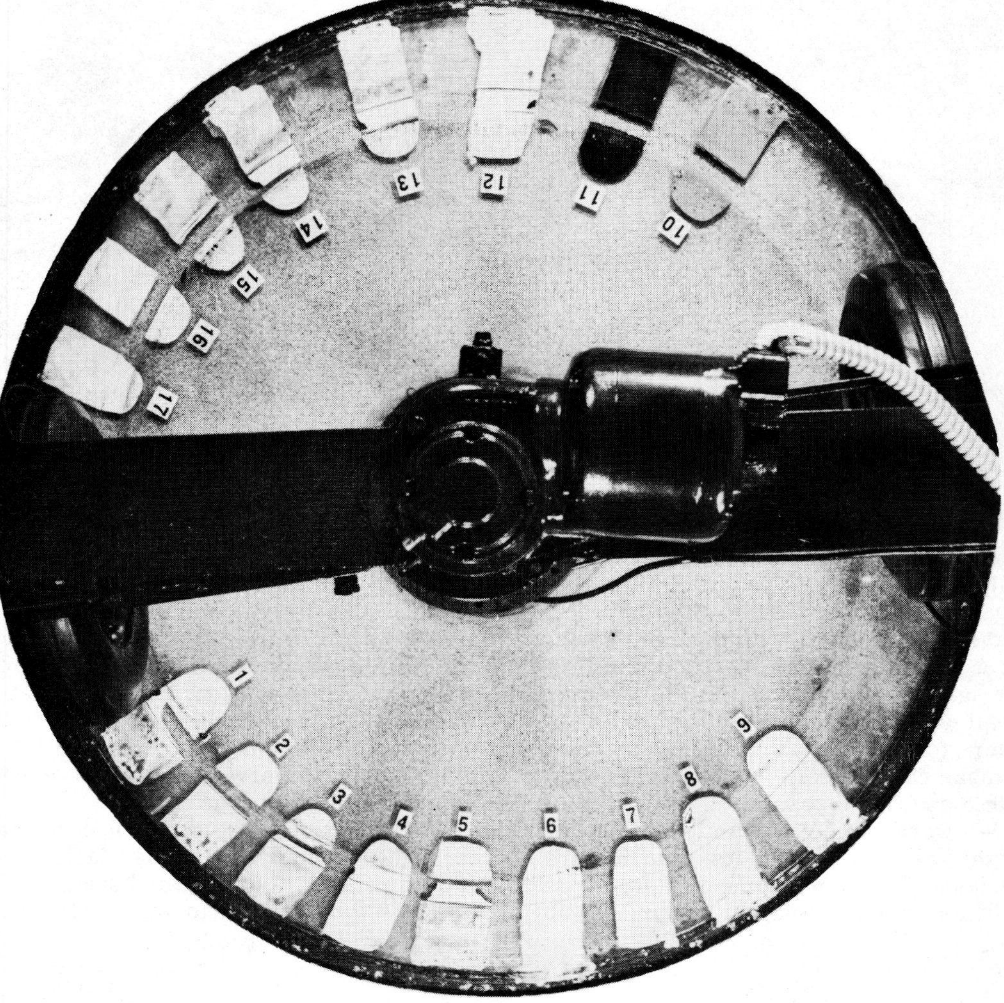


Figure 3.

ment, wet. The results obtained from this apparatus show fair correlation with those obtained on the highways (Fig. 3). All of these stripes were subjected to the same treatment. The types indicated here as II, III, IV, V, are defined below. Type I is not included in this series. Stripes 1 and 2 are Type II. Stripe 3 is Type III. Stripes 4, 6, 7, and 8 are Type V. Stripe 5 is Type V. Stripe 16 is a widely advertised proprietary traffic paint, beaded. Stripe 17 is Type IV, beaded. Stripe 9 is the paint used by the State of Washington. All others are nondescript experimental products. This series of stripes was subjected to 75,000 passes of wheels, dry, after which 25,000 passes were made wet. Transverse traffic lines exposed for many weeks prior to the acquisition of this apparatus gave results in general agreement with those that are obvious on the glass. Unfortunately, no photographic record was kept of these experiments. The results, however led to our large-scale procedure.

Last year we issued invitations for bids on five different vehicular types of traffic paint. These were: I, the D. B. B. chinawood oil; II, Alkyd; III, dispersion resin; IV, chinawood oil-pentalyn varnish-chlorinated rubber; and V, modified phenolic resin-castor oil-chlorinated rubber.

Awards were made for 10,000 gallons

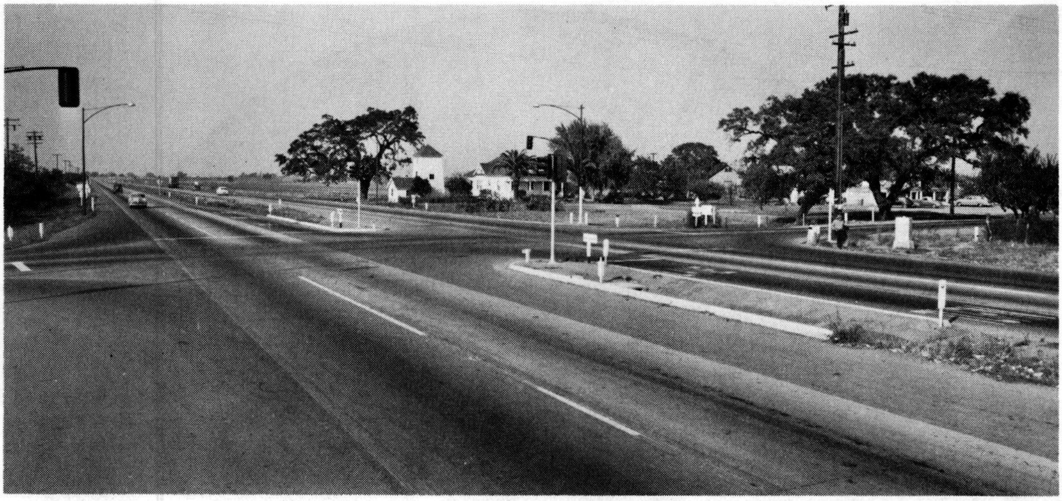

Figure 4.

Type I, 50,000 gallons Type II and 5,000 gallons each of Types III, IV and V. Pigmentation was left to the discretion of the manufacturer with the requirement for a minimum of 200 sq. ft. of coverage per gallon. We had made extensive small-scale tests on these and many other formulas and it was our intent to make comparisons on the larger scale with these five types.

We were compelled to discard Type V in the early stage of its manufacture, because of the development of incompatibilities in the container. Further observations of our small-scale tests had reduced our enthusiasm for this paint anyway. Each type was sent to all districts in the state, and an attempt was made to evaluate each at intervals following its application. The evaluation was limited, as far as possible, to the observation of one man, in order to maintain a comparable judgment on each paint in all parts of the state.

California affords varieties of climate throughout the year. This fact is of importance, not only to our booster clubs and joke writers, but to the traffic-paint

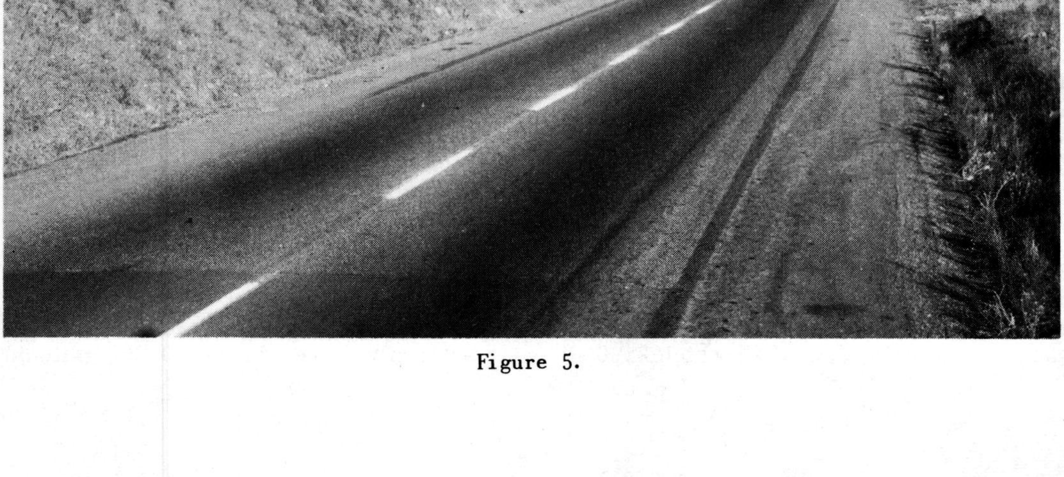

Figure 5.

engineer as well. We found a great diversity in the general acceptability of the various types of paint in different parts of the state. In the San Francisco Bay area, where the mean temperature is low and moisture conditions are annoying during a great part of the year, the alkyd formulations were disappointing, to say the least. In one case, the alkyd stripe was placed on a cold day preceding a heavy rain storm during the night. The stripe had practically disappeared within 10 days. In other cases where the alkyd was placed under favorable conditions, it has given good service for many months. It shows exceptional value as a holder of glass beads (Fig. 4). This stripe, near an intersection where wear is heavy, shows typical state of alkyds that have had favorable conditions of application after 7 months exposure to traffic of about 6,000 vehicles daily. However, its tendency to remain tacky for a long time results in a dirty film surface due to traffic and causes many complaints from the painting crews and sometimes from motorists. The surface will clear up and become comparably respectable in a few days, but the feature is still undesirable. It also has a tendency to surface dry and skin in shaded areas in the mountains and this behavior results in pickup by traffic, even after an hour or more of exposure.

We have experimented with formulations which eliminate many of the undesirable features of the alkyds. One of the more interesting of these, on an experimental scale, is the use of a vehicle which develops an incompatibility in the early stages of solvent evaporation. This is done by use of a conventional alkyd of about 42 percent phthalic anhydride content, such as Reichold's solid Beckosol No. 7 with a heat bodied oil. Preferably castor, such as Bakers 403; or a $Z_3$ linseed, oil may be used. These oils are incompatible with the alkyd. However, in fairly high dilutions with solvents the incompatibility disappears, and an oil content of about 15 percent may be used without necessitating undesirable thinning. Such a vehicle properly com-

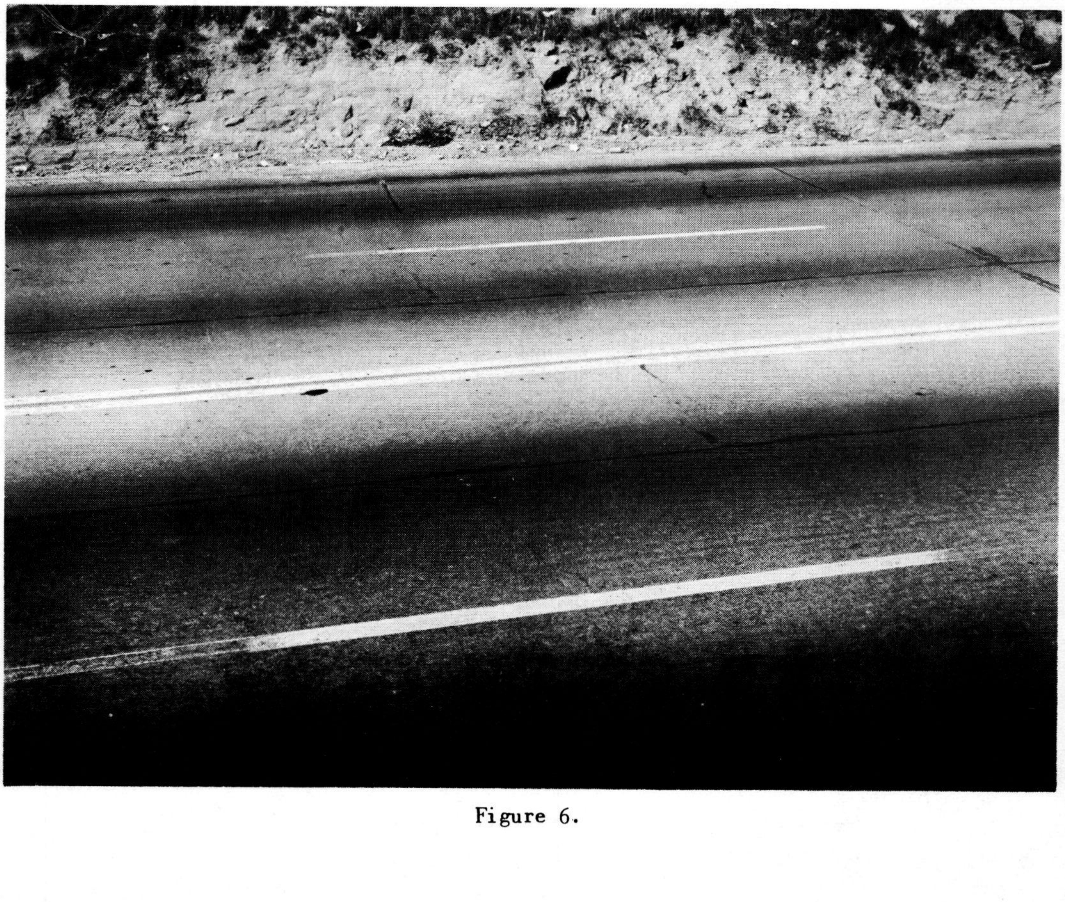

Figure 6.

pounded with pigment displays remarkable drying properties (a so-called false dry) without many of the afore-mentioned faults. The film from such compounding is relatively soft for a time and on abrasion tests has been a notorious failure. Nevertheless, when placed on highways under heavy traffic conditions, it has shown unusual durability and exceptional bead retention even through wet weather. We hope to expand our knowledge of this formulation and perhaps exploit its properties on a larger scale.

Our Type III has been dropped from consideration, temporarily at least. It had some of the deficiencies of the alkyd but was particularly criticized by the paint crew as having "no body." The resin content, the viscosity, etc. were all there, but it showed a tendency to spatter all over the highway when sprayed from the striping machine. Once down and dried, the wear and overall performance of the product has been eminently satisfactory. The comparative tendencies are shown photographically in Figure 5. The first stripe in the foreground is Type I, 10 months exposure. The background stripes are of Type III, 6 months exposure. Traffic count is approximately 6,000 vehicles per day. The pavement is asphalt. Given some time to study its peculiarities, Type III could be made quite acceptable in our opinion.

Type IV gave the best all-purpose, all-weather, all-state results we have had to date. Complaints have been practically nil and the performance so far has been highly satisfactory. It has appeared to be equally proficient on either asphaltic or concrete pavements. It dries quickly, holds beads well and shows great durability. It is not so sensitive to weather conditions as are many other formulations. Figures 6, 7, and 8 show segments of one of the more difficult highways from a traffic paint standpoint. The pavement is concrete, the traffic in excess of 30,000 vehicles daily, and the atmosphere is alternately wet and dry, bright and cloudy. The single lines of the traffic stripe are Type IV of 8 months ex-

Figure 7.

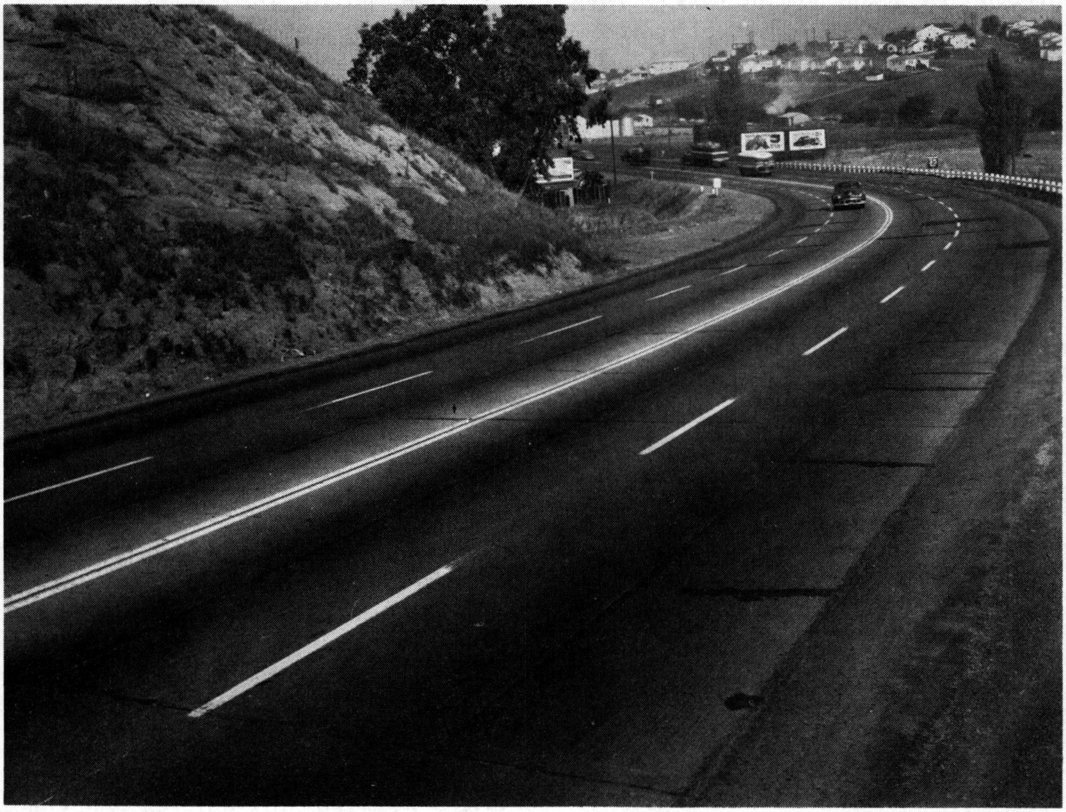

Figure 8.

posure. The double lines are of Type I of unknown exposure. The single lines are in excellent condition. Although they are badly soiled by grease and traffic dirt in some places, they glow beautifully at night and give a fine outline in moderate fog.

Because of this apparent superiority, it is perhaps not out of order to detail its composition. The vehicle was made by blending a varnish of 50 percent solids with a 25 percent solution of 10 centipoise Parlon, one to one. The varnish was composed of Hercules Pentalyn 802A, 25 gallons in oil length, 40 percent chinawood and 60 percent linseed. The pigment was composed of 10 percent minimum of titanium oxide, 5 percent zinc oxide, 50 to 55 percent lithopone, 10 percent talc, 5 percent mica, 10 percent celite 281 and 5 to 10 percent whiting with sufficient blue to overcome the yellowish tint. The pigment volume concentration was 45 percent. The solvent and thinner used throughout was essentially aromatic. The viscosity was set at 70 Krebs units with a tolerance of 5 units.

The oil in the varnish noted above is subject to wide variation in composition. It may be all chinawood or all linseed -- we have used the former with success. The latter has proved satisfactory in small laboratory batches, but we encountered some difficulties in a tendency of the finished product to thicken, especially if it contained zinc oxide. The overall compatibility is assured with 100 percent tung oil but is somewhat doubtful with 100 percent linseed. It is our opinion that a 75 to 25 ratio of tung to linseed is perhaps approaching an optimum combination. Our laboratory abrasion tests indicate a higher resistance in the blends than in either of the single-oil varnishes.

In the preparation of the varnishes we have requested that the wood oil be cooked to a gas-proof stage, while avoiding an over cook. Although gas proofing is probably not necessary to produce durability, good technology would require it to assure stability of the final product. This resin-oil-chlorinated-rubber combination is a complicated system and in the presence of zinc oxide may react in an undesirable way if any tag ends are left loose.

At the present time we have confidence in this chlorinated-rubber type of traffic lacquer. Although it is possible that this paint may not prove satisfactory, it has been successful in all parts of the state so far. We need further experience during the rainy season before stamping it with our unqualified approval. Recently one of our painting foremen stated that this new product had increased his production by 25 percent. Indications are that it will do as well in durability. We have no illusions as to the perfections of this product; we expect to improve it, especially when raw materials become available in abundance.

In an experimental way we have found several formulations that appeared to be excellent. One of these, mentioned earlier, was substituted for Type V. This was a Pentalyn A - linseed oil varnish with a pigment similar to that given for the Type IV and chlorinated-rubber content of about 3 percent based on the total paint. This product had been quite satisfactory in small-scale experiments and showed good stability in the can. A 500-gal. batch was sent to a district for trial there. A striping truck, equipped with two 80 gal. tanks, was loaded and striping started. While one tank was being used, the second was being agitated. When the first was used up and the service line switched to the second tank we found its contents to be of a consistency of a thick mayonnaise. We were never able to reproduce that phenomenon in the laboratory with small samples. The manufacturer could do it in large vats by agitation and slightly elevated temperature. He eliminated the difficulty by use of small quantities of butanol, but we abandoned the formulation.

Another formulation which has given considerable promise is Pliolite (styrenated butadiene) with a mixture of chlorinated paraffins -- better known as the Texas formula. This product has exceptional possibilities in unbeaded lines for cross walks, etc., but we have found it to be a relatively poor bead holder and have experienced some difficulties in securing proper viscosities for uniform application. However, a 20 percent pigment volume concentration (titanium and zinc oxides) in this vehicle produces an excellent cross-walk product of great durability. The vehicle is likewise readily adaptable to curb-marking paints of a highly satisfactory type, but the limited compatibility of the Pliolite resin restricts the range of its potentialities in a traffic paint.

We believe it is desirable to make a study of the PVC for each vehicle. PVC seems to exert a tremendous influence on the durability and bead retention, and it varies with radically different vehicles. Generally we find an optimum PVC which is a compromise between durability and drying time requirements. In our experience, relatively low PVC gives better durability if the stripe is allowed to dry; and bead retention is somewhat better. Beads, we find, extend the life of the stripe from 50 to 100 percent.

We are eyeing new resins appraisingly. Epon and the vinyls which are making such headway in the anticorrosive field are on our list for investigation. Possibly ethyl cellulose in combination with spirit soluble oils may offer some promise. Eventually, we hope to develop our paint technology to match the performance of mechanical applicators.