PROJECTED LABORATORY DEVELOPMENTS

I. INTRODUCTION.

"Projected Laboratory Developments" is the designated title of this talk. The objective is to discuss some of the problems that face us in the development of coatings for the near future and the approaches and solutions to be found in the laboratory.

At a recent joint Technical-Manufacturing Conference of the Glidden-Durkee Comany in Baltimore, Mr. William D. Kinsell Jr., vice-president of the Coatings and Resin Division put the challenge in these words: "To what extent is Research and Development time, money and effort being devoted to the maintenance of yesterday's product which is already doomed to extinction by the needs of tommorrow's market? Are the product development and technical service functions seeking to determine the cutomer's needs of the immediate and long term future, or are they devoted to the solutions of today's and yesterday's problems?"

II PROBLEMS.

To meet these challenges then it is necessary to define these unstated problems, to consider possible approaches and proceed to the laboratory for confirmation and to establish the validity of that solution.

The problems that face both the formulator and the end user of today's coatings are many and varied. These problems may range form the component raw materials that go into the coating to its final appearance after application to its ultimate performance. This problem spectrum is superimposed on the continuing need for and expected improvements in the protective and cosmetic values. What are these additional requirements?

Ecology is not a new word but not until recently has it become a common word in our daily vocabulary. It needs no definition but its impact on the socio-economic patterns of our lives has been great. For example, what had started out as local legislation to meet local conditions due to a unique meteorological phenomena in Los Angeles County as Rule 66 and in San Francisco as Regulation 3 is now spreading across the country. The probability of increasingly stringent Federal, State and local regulations in the area of controlling solvent emission is fast becoming a reality.

PROBLEM NO.1 HOW BEST TO SOLVE THE SOLVENT EMISSION PROBLEM?

Related to the ecological problem of solvent emmission is the concern of the use of heavy metals, specifically, that of lead and mercury in coatings. Use of mercurials is wide spread in the coating industry as an in-can preservative of many latices and emulsions as well as a mold inhibitor in the exposed dried film. Not only is the coating manufacturer faced with the problem of replacing the mercurials with effective non-mercurial, he is also faced with the disposal of wash wash solutions both solvent and water, used in the cleanup of equipused to produce those products which contain mercurials.

Lead pigments are widely used as colored pigments as well as anti - corrosive pigments. The 91st Congress recently passed an Act to provide financial assistance to help cities and communities to develop and carry out intensive local programs to eliminate the cause of lead paint poisoning. This, of course, covers only paint already applied. Title IV of the same Act deals with the future of lead paints. In short and terse terms it directs HEW to take such steps and impose such conditions as may be necessary to prohibit the use of lead paints in residential structures constructed or inhabited after the date of the enactment of this Act. Full details may be found in the February 16th issue of the American Paint Journal. This Act is narrow in its present scope.but its ban of lead into other areas is almost a predictable certainty.

II. PROBLEMS.

To meet these challenges then it is necessary to define these unstated problems, to cosider the possible approaches

Perhaps more problems exist and continually arise in the area of application than in any other area. The cost of application per coat or better yet the cost per mil dry film is perhaps the largest single cost factor to be considered in maintenance painting. It is also true that there is a direct correlation between performance and film thickness. Thus to reduce the number of coats required to produce a given film thickness should result in a lower per mil appliction cost. However this must be achieved without loss of performance.

PROBLEM NO.3 HOW CAN HIGHER BUILD BE OBTAINED IN LESS COATS WITH EQUAL PERFORMANCE?

As stated in the beginning of our discussion improved performance within a generic type of product is inherent in all development work. Thus, improved allyds, urethanes, epoxies, etc, are constantly introduced, These are hard earned incremental but expected improvement.

On the other hand certain resins exhibit outstanding properties such as for example chemical resistance but with relatively poor gloss retention. Still another resin may have these same properties in reverse.

PROBLEM NO. 4 . CAN THE DESIRABLE PROPERTIES OF A GIVEN RESIN BE COMBINED WITH DESIRABLE FEATURES OF ANOTHER AND AT THE SAME TIME MINIMIZE their respective weaknesses?

Conditions at the time of application have immense effect on the ultimate performance of a coating. Rain, dew, ambient temperature, surface temperature, humidity, etc. are impossible to control completely. Climatic conditions limit the exterior application season.

PROBLEM NO. 5. HOW TO EXTEND THE APPLICATION SEASON AND/OR IMPROVE APLICATION UNDER LESS THAN DESIRABLE OR IDEAL CONDITIONS WITHOUT ADVERSE EFFECT ON THE PERFORMANCE?

The nature of maintenancepainting is such that its needs relate to:

a. Practival dollears and cents economics. What are the cost advantages of painting over the cost of replacement of a substrate or structure.

b. Required or self imposed standards such as light reflectance, safeth and health codes.

c. subjective values associated with overall appearance, color, etc.

All of these requirements place an obligation or responsibility on both the manufacturer as well as the buyer of coatings.

PROBLEM NO. 6 HOW CAN THE REQUIREMENTS OF THE MANUFACTURER TO PRODUCE AND THE BUYER TO PROCURE BEST BE MET FOR MUTUAL BENEFIT AND SATISFACTION?

III APPROACH TO SOLUTIONS.

To logically find solutions to these problems it is necessary to establish where we are and use that base as the starting point. Solutions must be found within the matrix of the component parts that go to make up a coating, namely,

1. Vehicle solids.
2. Pigment solids.
3. Solvent volatiles.

For purposes of review let us briefly list the generic types of vehicle or resin solids in use today:

1. Alkyds
   a. linseed
   b. soya
   c. castor oil
   d. safflower
   e. fish
   f. tung
   g. mixed oils
2. Modified Alkyds
   a. acyrlic
   b. rosin
   c. phenolic
   d. silicone
   e. styrene
   f. vinyl toulene

3. Acrylics

   a. homopolymers

   b. interpolymers

4. Drying oils

   a. same as those listed under alkyds.

5. Oleoresinous

6. Urethanes

   a. moisture cured

   b. oil modified

   c. prepolymer

   d. blocked

7. Silicones

8. Vinyl Chloride copolymers

9. Latices

   a. acrylic

   b. vinyl acetate

   c. styrene butadiene

10. Epoxy

   a. esters

   b. amino catalyzed

   c. amide catalzyed

11. Asphaltic and coal tars

12. Shellac, cellulosic, chlorinated rubber, inorganics,

This list is by no means exhaustive or all inclusive. It is intended to be used as a guide in our approach to the problems posed. Of the types listed the alkyd is still the "work horse" by accounting for better than 50 % of all maintenance coatings. Projections of raw material consumption indicate that alkyds will continue in a position of strength but being strongly challenged by the various laticos. The others string out behind the two unquestioned leaders.

In the pigment field titaniums continue to be a front runner, particularly with the availability of the chloride process type. Zinc oxide is a poor second.

In the solvent group the principal types are:-

1. Aliphatic hydrocarbons
2. aromatic hydrocarbons
3. terpenes.
4. oxygenated solvents
    a. alcohols
    b. ethers
    c. esters
    d. ketones
5. halogenated hydrocarbons
6. nitroparaffins
7. water.

Against this background let us consider the solutions to the porblems/.

IV. SOLUTIONS.

Problem No. 1 How to solve the solvent emission problem?

SOLUTION A. An obvious solution is to replace the non- conforming solvent with a solvent that does comply with the requirements. In the case of mineral spirits this has been relatively simple.in as much as a single direct replacement was readily available. These mineral spirit replacements were of lower aromaticity therefor of lower solvency which resulted in slightly higher viscosity and at times slightly slower set up times. Additional formulation adjustments minor in nature had to be made to compensate.

To replace aromatics such as xylol or branched chained solvents such as MIBK is a little more difficult because a single direct replacement was not available. Instead combinations of solvents had to be blended to individual requirements.

At the outset of the solvent emission regulations the replacements were worked out empirically. Today the replacement combinations are derived form sophisticated computerized programs based on solubility parameters, hydrogenbonding factors, etc. With this tool available solvent emission problems should not be critical to solve.

SOLUTION B. Still another solution is to eliminate the solvent entirely by resorting to solvent free or 100% vehicle solids coatings. This would require some reformulation of the base resin to adjust for good application. Such coatings are feasible as is witnessed by various epoxy formulations. Other resins are being considered for adaptation to this technique.

SOLUTION C.

If a replacement solvnet is not available or does not produce the desired result, consideration should be given to converting the resin from a solvent solution to a water soluble resin. Many of the resins listed can be solubilized in water by the use various coupling agents tp eliminate the objectionable solvent or solvents. This solution is adequate in some cases whereas in others it may introduce water sensitivity or residual odors. Many alkyds and acrylics have been converted by this mechanism to satisfactory water reducibility.

SOLUTION D.

If water solubility is not the complete answer another technique to consider is the emulsification of the resin. This has been successfully used with epoxy esters, chlorinated rubber and even with two package catalyzed epoxy systems. This technology is being refined daily and may well be the best answer for many of today's solvent coatings.

GLD 006449

SOLUTION E.

Another solution to solvent emmsion is a variation of 100% solids

coating, namely powder coating however, it is applicable to production line finishing. It is cited only as an example of how such problems can be approached.

PROBLEM NO. 2 WHAT TO DO ABOUT MERCURY AND LEAD REPLACEMENT?

Solution: Many non-mercurials are available and on testand in many cases already in formulations. Current literature is devoting a lot of space to this problem that can readily be referred to . In any case no one non- mercurial has emerged as the outstanding replacement. However,as tests and exposures continue the problem will be resolved.

Lead pigments have served long and faithfully in the coatings industry both as a colored pigment and even more importantly as an anti -corrosive. The objection to the use of lead is its toxicity especially during application and the potential danger during the life of the film by accidental ingesting.

Where lead pigments have been used for their chromoticity they have been largely replaced by non toxic organiss.

In the anti-corrosive field the lead replacement has been more difficult because of its long record of reliable performance. The potential replcements such as calcium chromate, calcium molydate, zinc phosphate, iron phosphate and barium metaborate have much shorter field exposure hence their performance is still under consideration. However, the rpports are encouraging. Each has some merit and in the case of the last four an additional advantage is gained by the fact that they are white. This may herald a new series of colors for primers other than the tradional reds, oranges and olive drabs.

PROBLEM NO. # HOW CAN HIGHER BUILD BE OBTAINED IN LESS COATS WITH EQUAL PERFORMANCE?

SOLUTION A. The solution suggested as an answer to the solvent emmission problem can also be used to obtain higher buid, namely, the 100% solids or solvent free coating. Properly formulated the solvent free coating can give higher film build. This has been demonstated as being practical in certain epoxy coatings. This may result in higher costs per unit purchased volume but could concievably result in lower cost per mil dried film.

Solution B. higher build application may be attained by the use of thixotropes without sag. To do so the coating must be formulated for complete through dry and good solvent release so as not to give surface dry and a soft cure below the surface which would eventually lead to checking and alligatoring.

SOLUTION C. Vehicles with high gel structure have been developed. These in turn have been formulated to give pigmented products of excellent structure that readily break down under the shear of the brush, roller or spray but recover rapidly to permit high mil application without sag. Alkyds are particularly amendable to this technique.

PROBLEM NO. 4 CAN THE DESIRABLE PROPERTIES OF TWO GENERIC RESINS BE COMBINED RIGHT? AND AT THE SAME TIME MINIMIZE THE LESS DESIRABLE PORPERTIES OF EACH? CAN WE HAVE THE BEST OF TWO RESINS IN ONE FINISH?

SOLUTION: The coatings industry is no longer as beholden to naturally occuring oils and resins as it had once been. The loosening of this dependence on nature has been a long and continuing process of evolution as coating technology moved from an art to a science.

Today through the expertise of our resin chemists the genetics of a resin can be controlled and designed to produce a desired resin. It can be "tailormade". Thusif an epoxy resin is selected because of its superior chemical and solvent resistance it can be designed to combine with an acrylic with good gloss and color retention properties by grafting a functional group for example an isocyanate on one of the polymers and a corrosponding reactive group such as a hydroxyl to the other. True, this results in a two package system but the finish has properties not obtainable in either individually.

PROBLEM NO. 5 HOW TO EXTEND THE APPLICATION SEASON AND/OR IMPROVE APPLICATION UNDER LESS THAN IDEAL CONDITIONS./?

SOLUTION: /As A similar approach to that proposed in the last problem is suggested, namely, specifically designed two package systems. Since such systems cure by chemical crosslinking they are not as dependent on favorable atmospheric conditions as ~~conventional air dry oxidation~~ those dependent on air oxidative mechanism.

PROBLEM NO. 6 How can THE REQUIREMENTS OF THE MANUFACTURER TO PRODUCE PROFITABLY AND THE BUYER TO PROCURE COMPETITIVELY BE MET?

SOLUTION. This perhaps is not a quetion to be entirely resolved in the laboratory it should nevertheless be considered. With consumer organizations growing stronger in their demands there is a possibility that Washington will intensify efforts to set product standards for consumer goods. Some thought should be given to performance standards that will truly reflect the needs of the user.

V. SUMMARY

Briefly some of the problems envisioned for the seventies were discussed and solutions suggested. Ecological considerations loom large in the near future. In our industry these are concerned with solvent emission and the elimination of lead. Solutions to these problems not only resolve the ecology conflict but could lead to improved polymer systems and higher build coatings.

In conclusion I would like to mention additional topics of interest but not discussed. The concept of hiding without pigments is coming up more and more. This development colud result in some significant changes in the industry.

One resin system that warrants watching is the fluocarbons. These have beenominently successfully in coil coatings with long range durability.

With the expensive sandblasting costs in the field , the pre blasted steel becomes more attractive. If this develops intio a trend fast dry weldable shop primers willbe come a major new development. Such coat