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STANDARDS AND
INDUSTRIAL
RESEARCH



FINAL REPORT

TITLE : UNIDO Contract No. 93/113 - Project No. SI/SEY/92/801 Assistance to the Government of Seychelles in the improvement of the quality of paints

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1 EXECUTIVE SUMMARY

1.1 Introduction

The project entailed consultancy to the Government of Seychelles in improvement of the quality of architectural paints produced by Penlac Co, paint standardisation and paint testing facilities.

The project was executed by a team of Consultants from the Singapore Institute of Standards and Industrial Research (SISIR) led by Dr Loh Wah Sing, Deputy Director, Materials Technology Division, SISIR.

Key parties participating in the project are Seychelles Bureau of Standards (SBS) and Penlac Co in Seychelles

1.2 Achievements of the project

1.2.1 *Penlac Company*

- i) Two staff members of Penlac were trained on paint sample preparation, evaluation of paint raw materials and finish product testing. Training included laboratory work in SISIR, visit to local paint factory and painting site.
- ii) SISIR has helped Mr Pothin, Factory Manager of Penlac to establish a link with a Singapore paint company during his training in SISIR. Penlac may capitalise on the opportunity to compile information on quality and price of raw materials from alternative sources from the East.
- ii) Penlac has started to document complaints from clients, which is an encouraging sign for customer service.
- iv) Batch number system for finished paints has been introduced.
- v) Penlac has purchased drying time recorder and started to monitor oil absorption of pigments
- vi) Penlac has succeeded to sterilize the water used in producing emulsion paint. This is a key step in preventing generation of fouling smell from the paint upon storage.
- vii) Penlac has sought cooperation of dealers to practice first-in-first-out in inventory control.

- viii) Penlac is working out a quality management programme based on adaptation of ISO 9002 as a prerequisite to apply for SBS Mark for its Pentop Emulsion Paint. Mr I. Joseph of SBS will follow up. Among others, the open-minded attitude of the senior management of Penlac is paramount in ensuring the production of quality paints to their customers.

1.2.2 *Seychelles Bureau of Standards*

- i) A paint testing laboratory was set up and manned by a competent technician, who was given training in SISIR in paint testing and laboratory documentaton. Equipped with the facilities as recommended, SBS is in a position of providing quality surveillance for the paint used in Seychelles. SBS will open up the facilities to Penlac as it will not be feasible for the two organisations to duplicate the purchase unless the instrument is meant for daily use.
- ii) SBS has revised SS26 on emulsion paint to incorporate recommendations of the consultant for adoption of the latest versions of ISO test methods and for updating product quality attributes to be commensurate with current practice.
- iii) Representative from Penlac has been invited to the standards committee on paints. It provides a means to get the commitment of the paint manufacturer in product standardisation of paints in Seychelles to ensure that the resulting standards are practicable.
- iv) A specification for minimum quality requirements for imported paint is in place. It ensures that paint users in Seychelles will get value for money and gives Penlac a levelling ground in business competition.

1.3 Conclusion

Through manpower training, provision of essential equipment and agreement in quality management reached in meetings with personnel of SBS and Penlac, the direction and path have been established for future tasks to be undertaken by SBS and Penlac, SBS being charged with the task of overseeing implementation of the quality management by Penlac. It is deemed that the infrastructure developed thereof has fulfilled the objectives dictated in this UNIDO Project. As quality improvement is an on-going activity, the parties concerned can take up from here to continue to accomplish their tasks.

2 INTRODUCTION

The project entailed consultancy to the Government of Seychelles in improvement of the quality of architectural paints produced by Penlac Co in Seychelles. As an associated activity, a specification on minimum quality of imported paints was also drawn up to ensure fair competition of the supply of paints in Seychelles.

The project was implemented by the Singapore Institute of Standards and Industrial Research (SISIR). The project team members are

Dr Loh Wah Sing, Deputy Director, Materials Technology Division - lead consultant,

Ms Lin Tai Hoe, Scientific Officer, Chemical & Surface Technology Centre plus a team of technical supporting staff of the paint laboratory

Prior to commencement of the project, a technician, Miss Veronica Labrosse, of the Seychelles Bureau of Standards was sent to SISIR for a four-week training in paint testing from 10 May to 5 June 1993 by the Government of Seychelles.

A technical advisor, Mr E. H. Jackson had been engaged by UNIDO on a four-week assignment in Seychelles to find out on the state of the paint factory of Penlac. A report by Mr Jackson reference SI/SEY/88/802/11-01/J12102 dated 30 July 1992 was given by SBS which provided a good account of background information for the current project.

Both Miss Labrosse's pre-project training in SISIR and Mr Jackson's information has facilitated implementation of the present project.

The Seychelles parties involved in the project are Seychelles Bureau of Standards (SBS) and Penlac Company. Appendix 1 shows the list of senior Seychelles personnel with whom the lead consultant met in the project.

It is given to understand that SBS play a dual role in this UNIDO project:

- As a third party certification body
- As representative of the Seychelles Government, who is a shareholder in Penlac Co Ltd, to look into areas where Penlac can make improvements.

3 PROJECT PLAN

The project commenced from July 1993 and completed with debriefing at UNIDO office in Vienna on 21 and 22 September 1994.

The project was divided into two main tasks:

i) *On-site consultancy*

Two missions to Seychelles were carried out by the principal consultant, from 1 to 6 Nov 1993 and 4 to 9 July 1994.

ii) *Provide training in SISIR for staff of Penlac and SBS in paint technology*

Personnel for training were identified during the two missions to Seychelles.

4 MISSIONS TO SEYCHELLES

4.1 Penlac Company

4.1.1 *Senior management's perception of the*

Mr A. Noel, General Manger of Penlac, expressed scepticism initially on the role of the UNIDO project in helping the company to work towards quality improvement of products. He maintained that Mauvilac was responsible for the technical management of the company and that paint formulas issued by Mauvilac to Penlac had to be referred back to Mauritius for any modification which had been practised to date.

On the contrary, Mr Pothin, Factory Manager, was very receptive to the work of this project and saw it as an opportunity to upgrade the quality of the paints. Mr Pothin understands the problems faced by the company.

However, there was an apparent change in attitude during the second mission to Seychelles by the consultant. Mr Noel stressed that quality was the first objective of Penlac. He highlighted the difficulties in getting test certificates of raw materials from vendors. He related that 19 % of the raw materials were supplied by Mauvilac and the remainder was purchased from external vendors through agents in South Africa. While reiterating the position of Mauvilac as the party responsible for technical management of Penlac, Mr Noel welcomed the assistance from UNIDO and stated that the decision lay with the management of the company in adopting the recommendations by taking into consideration the financial and

human resource constraints of Penlac.

4.1.2 *Quality of raw materials and paint*

There was a lack in quality control of raw materials. Poor quality of raw materials delivered to Penlac was evident. Following are some examples for illustration.

- i) Presence of significant amount of solid sedimentation in a consignment of solvent.
- ii) In a comparison test of emulsion paint samples in SISIR of imported brands and those produced by Penlac, scrub resistance of Pencryl emulsion paint was unexpectedly low (Appendix 2). Two reasons are conceivable. One is high polyvinyl acetate (PVA) content in the co-polymer acrylic latex. PVA is inferior to acrylic in scrub resistance. Another possibility is the use of an over-aged latex with a lower pH, causing hydrolysis of the PVA component to form acetic acid and polyvinyl alcohol which are highly sensitive to water and thus gave rise to low scrub resistance.
- iii) There were cases where varnish produced with alkyd resin supplied by Mauvilac turned green. It could be a sign of contamination of the resin with rust arising from contact with rusted container. The green colour could be a reaction between the driers and the rust contaminants.
- iv) Enamel paint produced from the alkyd resin used by Penlac was confirmed to show slow drying time (13.5 hours) compared to a paint sample produced from a similar resin available in Singapore (7 hours). The paint samples, based on Penlac's formula, were prepared by Penlac technician, Mr Eddie Sinon, as part of his training in SISIR.

Quality of paint produced by Penlac is affected by several factors, namely, the level of paint technology, quality of raw materials shipped from Mauvilac, in-process control in production of the finished paint, and management attitude towards grooming local staff in Seychelles for solving technical problems and in customer service.

4.1.3 *Feedback from customers of Penlac*

Visits were made to three major paint customers of Penlac whose particulars are given in Section A1.3 of Appendix 1.

Feedback from major paint users generally focused on batch-to-batch

viscosity and colour variation. Slow drying time of enamel paint was also highlighted, which tallied with results of the comparison test of Seychelles paint sample in SISIR as indicated in Appendix 2. There were occasions in which a wall sealer was not recommended (by Penlac) in painting specification for new wall.

Mr Seeger of Tropicolor, who is also a director of Penlac, pointed out the necessity for Penlac to identify raw materials that suit the climate of Seychelles.

However, there are signs of the company heeding the market force lately by undertaking the painting jobs as part of supply of the paint. A recent example is painting to the National Library in Mahe.

4.2 Seychelles Bureau of Standards (SBS)

4.2.1 *Standardisation of paint products*

There was one Seychelles standard on paint, namely SS26:1992, "Specification for emulsion paints for interior and exterior use".

A review was made to the standard and recommendation to amend certain attributes and test methods to bring them in line with current practice. The recommendations are tabulated in Appendix 3.

There was no representation in the paint standards committee from major users, manufacturer, engineers or architects related.

Samples of emulsion paint, produced by Penlac and of imported brands, were sent to SISIR for evaluation. Poor wet scrub resistance (Appendix 2) of two of the imported brands, Stanley and Multiflat, was evident.

Results of the comparison test point to the need to have a minimum quality attributes for paints to used in Seychelles. It also allows Penlac to compete in the market on a levelling ground. Specifications for minimum quality requirements of emulsion paint and enamel paint were drawn up as shown in Appendix 4.

4.2.2 *Paint testing laboratory in SBS*

SBS has allocated an air-conditioned laboratory, dedicated for paint testing.

The following paint testing equipment, as per UNIDO Purchase Order No. 15-3-0762a dated 21 July 1993 and per delivery order No. 1272 of Braive

Instruments dated 30 Aug 1993 were installed and found to be in working conditions, unless commented otherwise.

- i) Opacity meter - device for film preparation, shim and polyester sheets were not delivered)
- ii) Krebs-Stormer viscometer
- iii) Flow cup Ford No. 4 (a stand for the cup was not ordered)
- iv) Density Cup (pycnometer)
- v) Film applicators
- vi) 3-speed B K Drying Time Recorder
- vii) Light cabinet with lighting sources to simulate day light and fluorescent light - for visual comparison of colour
- viii) Wet Scrub Tester
- ix) Gloss meter
- x) Thermostatic water bath

The laboratory is also equipped with an analytical balance, a desiccator, a laboratory oven and an outdoor exposure rack for outdoor weathering test of paint.

An additional list of paint testing equipment was identified during the second mission to Seychelles. The list together with the shortfall of delivery was faxed to UNIDO office on 18 Aug 1994 (Appendix 5).

An inspection of the laboratory record book showed that there was room for improvement in documentation of testing (Appendix 6). A recommendation to train a SBS technician was proposed as indicated in para 4.3.

4.3 Training for Seychelles personnel

4.3.1 *Penlac staff*

Two Penlac staff were sent to Singapore for hand-on training with the objectives of understanding the approaches and tools required to implement an effective quality control programme in paint production. The training included

laboratory work in SISIR and visits to paint factory and painting site. Particulars of the trainees and period of the training are:

- Mr Nicolas Pothin, Assistant General Manager - 28 Feb to 12 Mar 1994
- Mr Eddie Sinon, Laboratory Technician - 4 to 16 Apr 1994

Mr Pothin was attached to a Singapore paint manufacturer for three days. This enabled him to relate the different aspects of quality control in raw materials and production process in order to produce quality finished products.

Mr Sinon was brought to visit a painting site of high-rise residential buildings with the objective of understanding the current painting practice by professional painters in Singapore. He witnessed the use of mechanical gondolas and high pressure water jets for cleaning of wall surface prior to painting.

Training reports submitted by Mr Nicolas Pothin and Mr Eddie Sinon are given in Appendices 7 and 8.

4.3.2 *SBS staff*

During the second mission to Seychelles, it was noted that SBS would benefit in laboratory management by sending a technician for a further two-week training in paint testing at SISIR, although such training was not provided for in the original schedule. The objectives of the training are

- i) to understand, through correct selection of the correct option of a method to match with the type of paint product, the impact of sample preparation and controlled condition of test on reliability and reproducibility of test results.
- ii) to inculcate the importance of systematic recording for easy retrieval and as an integral part of quality assurance in laboratory practice.

An SBS technician, Miss Veronica Labrosse, was sent to SISIR for a two-week training starting from 25 July 1994. Her training report was given in Appendix 9.

5 ACHIEVEMENTS OF THE PROJECT

5.2 Penlac Company

- i) Penlac is working out a quality management programme based on adaptation of ISO 9002 as a prerequisite to apply for SBS Mark for its

Pentop Emulsion Paint. Mr I. Joseph of SBS will follow up. Among others, the open-minded attitude of the senior management of Penlac is paramount in ensuring the production of quality paints to their customers.

- ii) Penlac has started to document complaints from clients, which is an encouraging sign for customer service.
- iii) Batch number system for finished paints has been introduced.
- iv) Mr Pothin indicated new paint formulations forthcoming from Mauvilac.
- v) Penlac has purchased drying time recorder and started to monitor oil absorption of pigments
- vi) Penlac has succeeded to sterilize the water used in producing emulsion paint. This is a key step in preventing generation of fouling smell from the paint upon storage.
- vii) Penlac has sought cooperation of dealers to practice first-in-first-out in inventory control.
- viii) Management and laboratory personnel sent to Singapore for attachment training in SISIR understand the steps required to achieve quality products
- ix) SISIR has helped Mr Pothin of Penlac to establish a link with a Singapore paint company during his training in SISIR. Penlac may capitalise on the opportunity to compile information on quality and price of raw materials from alternative sources from the East.

5.2 Seychelles Bureau of Standards

- i) A paint testing laboratory was set up and manned by a competent technician. Equipped with the facilities as recommended, it is in a position of providing quality surveillance for the paint used in Seychelles.
- ii) SBS has revised SS26 on emulsion paint to reflect part of the recommendation by the consultant. A further refinement was recommended as shown in Appendix 10.
- iii) Representative from Penlac has been invited to the standards committee on paints. It provides a means to get the commitment of the paint manufacturer in product standardisation of paints in Seychelles to ensure that the resulting standards are practicable.

- iv) A specification for minimum quality requirements for imported paint is in place. It ensures that paint users in Seychelles will get value for money and gives Penlac a levelling ground in business competition.

6 FURTHER RECOMMENDATIONS

Quality improvement is an on-going exercise. Based on the achievements made so far, it is beneficial for both Penlac and SBS to consider the following proposals related to long-term improvement of the quality of paints used in Seychelles.

6.1 Penlac Company

- i) A core team of paint technologists shall be formed in Penlac. Laboratory scale mixers and mills shall be purchased to perform the following tasks.
 - a) Verify attributes (viscosity, density, solid content, drying time, fineness of grind) of paint formulas transferred by Mauvilac.
 - b) Evaluate new or substitute raw materials - Penlac technical personnel shall be given the necessary autonomy to select, in a cost effective manner, the type of raw materials that will perform satisfactorily in the climate of Seychelles.
 - c) Provide customer service - site inspection of paintwork; trial on new colours or customised colours.
 - d) Provide trial to salvage defective batch of paint - verify the method of reconditioning in small quantity before scaling up to the production lot. Examples are correction of colour shades, adjust drying time of enamel paint, mixing of a defective lot to a good lot etc.
- ii) High throughput mills, such as horizontal bead mills, shall be acquired to replace the three-rolled mill, which is time consuming in production. Dispersion of a mill base of organic pigment or carbon black by roller-mill takes one day and is labour intensive. In modern paint production facilities, the three-roll mills have been replaced with horizontal bead mills where the same dispersion can be completed in one hour.
- iii) As the factory is located near the seaside, there is an urgent need for the

company to install waste water treatment plant for treating effluent prior to discharge to the public system. A way shall also be found to collect waste solvent for disposal.

- iv) Attempt by Penlac to produce cheap emulsion paint to compete against imported brands has to be viewed with caution. Penlac is lacking the economy of scale enjoyed by large paint factories in producing low quality paint. The latter would have bargaining power in bulk purchase of raw materials at low cost, mass production facility from automatic charging of raw materials to packing, for producing low quality paints in a cost effective manner. Given the relatively small market served by Penlac, it will be in the long-term interest of Penlac, with the support of the Seychelles Government, to position itself as a producer of premium paint and promote the image of value-for-money for its products.
- v) Penlac may also wish to review the number of types of paints being produced in Seychelles. One can consider to produce only the core products where there is a relatively sizeable market. Other types of paint of relatively low demand could be imported in order to optimise logistics management.
- vi) Penlac needs to review the existing storage and production layout with a view to installing a technical service laboratory, installing pollution control plant and better organised materials handling. An alternative site shall be identified if it is found the existing site will not be able to cope with the planned activities.

6.2 Seychelles Bureau of Standards

- i) It is good practice to require colours of paints marketed in Seychelles to be matched to a national standard, e.g. BS 4800 or other relevant national standards. This is to allow for a unified code for colours, ensure closest reproducibility of colour shades among different brands of paints and for maintaining consistency in printing of colour charts.
- ii) In enforcing the above requirement, suppliers shall also be permitted to market a limited range of proprietary colour shades, which have no corresponding equivalent shades in national standards. This is to allow availability of sufficiently wide range of colours for selection by customers.
- iii) As a national body overseeing the quality of products used in Seychelles, it is beneficial for SBS to keep tab on product and specification development in other tropical countries.

- iv) Having finalised SS 26, SBS may wish to work on the next paint product specification, e.g. enamel paint. A recommended starting point is Singapore Standard, SS7 : 1970, "Specification For Paint : Finishing, Gloss Enamel". Certain product attributes, such as the range of viscosity and non-volatile content, can be modified to suit the market needs of Seychelles.

7 CONCLUSION

A meeting was held with Mr Joel Morgan and Mr Irene Joseph to review progress of the project at the end of the second mission to Seychelles. Both parties of SBS and SISIR were satisfied on achievement of the objectives of the project. SBS has agreed to the recommendations made by the lead consultant.

Through manpower training, provision of essential equipment and agreement in quality management reached in meetings with personnel of SBS and Penlac, the direction and path have been established for future tasks to be undertaken by SBS and Penlac, SBS being charged with the task of overseeing implementation of the quality management by Penlac. It is deemed that the infrastructure developed thereof has fulfilled the objectives stipulated in this UNIDO Project. As quality improvement is an on-going activity, SBS and Penlac can take up from here to accomplish their tasks.

8 ACKNOWLEDGEMENTS

The consultants wish to thank

Mr J. Morgan and Mr I. Joseph of SBS for facilitating the work of the lead consultant in his missions in Seychelles

Mr A. Noel and Mr N. Pothin of Penlac Co for their enlightening input to the UNIDO project

The clients of Penlac whom the lead consultant visited for their useful feedback on quality of the paints supplied in Seychelles

Mr A. Villard and Mr V. Kozlov of UNIDO office for their prompt response to the consultants' enquiries in the course of implementing the project.

Appendix 1 List of senior personnel met in Seychelles

A1.1 Seychelles Bureau of Standards (SBS)

Mr Joel Morgan
Executive Director

Mr Irénée Joseph
Director, Inspectorate & Certification Services Division

A1.2 Penlac Co Ltd

Mr Eddie R Belle
Chairman

Mr Andre Espitalier Noel
General Manager

Mr N.L.R. Pothin
Factory Manager

A1.3 Major paint users

Allied Builders Seychelles (Pty) Ltd
Mr Atul Bhatt, General Manager

Vijay Construction (Pty) Ltd
Mr V.J. Patel, Managing Director

Tropicolor Ltd
Mr George Seeger, Director

A1.4 Ministry of Foreign Affairs, Planning & Environment

Mrs Jeannette D'Offay
Director, Multilateral Affairs

Mrs Harisoa Lalatiana Accouche
Secondary Secretary

A1.5 UNDP Mauritius Office

Mr Arjen Kool, Junior Professional Officer

Appendix 2 Wet Abrasion Test of emulsion paint samples from Seychelles

SAMPLE	OBSERVATION
VIP SATIN (Penlac)	No exposure of substrate after 8500 cycles. 25 mm wear off after 9000 cycles.
PENTOP (Penlac)	No exposure of substrate after 8000 cycles. 10 mm wear off after 8500 cycles.
PENCRYL (Penlac)	No exposure of substrate after 1000 cycles. 10 mm wear off after 1500 cycles.
PLASCON (Imported paint)	No exposure of substrate after 1000 cycles. 10 mm wear off after 1500 cycles.
STANLEY (Imported paint)	10 mm wear off after 5 cycles.
MULTIFLAT (Imported paint)	10 mm wear off after 50 cycles

Appendix 3 Review of SS26:1992, "Specification for emulsion paints for interior and exterior use"

A3.1 Preamble of Product Specification

A product specification shall carry minimum requirements and yet sufficient to achieve a desired quality of the product. Updated version of test methods should be used.

A3.2 Product specification

Clause 2.1.4 Coarse particles and foreign matter

The test procedure is tedious and not amenable to in-process control.

Recommend to replace this requirement with fineness of grind or fineness of dispersion (ISO 1524) which can be readily carried out during production to monitor the adequacy of dispersion.

Clause 2.1.5 Consistency

The requirement specified (ISO 2884 : 1974) does not tally with the test method in Appendix C that uses a Krebs-Stormer Viscometer. ISO 2884 specifies a shear rate between 5,000 to 20,000 s^{-1} . Given the non-newtonian nature of pigmented paints, it is necessary to specify a shear rate for reproducible results. Krebs-Stormer Viscometer operates at 200 rpm with a given configuration of container and specified impeller and implies the test being conducted at a fixed shear rate.

Recommend to change the viscosity units from poise to Krebs Unit. Referral to ISO 2884 is unnecessary.

Clause 2.1.7 pH value of paint

Whilst pH adjustment is essential in production of emulsion paint, this attribute is not necessary in evaluation of quality of the finished product by a third party. An inappropriately adjusted pH will affect, among other things, storage stability of the finished paint.

Recommend to delete the requirement of pH from the product specification. Quality will not be compromised as the paint has to fulfil the storage stability requirements (Clause 2.1.8).

Clause 2.2.3 Drying properties

Unlike oil paints, which dry largely from surface to the interior of the paint, emulsion paint dries by evaporation of water and coalescence of latex particles. The coalescence will take place throughout the matrix of the paint film. Specification of surface dry is not necessary.

Recommend to delete the requirement of surface dry. It is sufficient to specify only the hard drying time for emulsion paint.

Clause 2.3.4 Hiding power

ISO 3906:1980 is an improved version of ISO 2814:1973. Through a procedure of interpolation at the spreading rate of 20 sqm per litre of paint, reproducibility of measurement of contrast ratio is enhanced.

The contrast ratio as determined by ISO 2814 or ISO 3906 is based on a spreading rate of 20 sqm per litre of paint. It is not understood how the contrast ratio so determined be converted to hiding power in terms of sqm per litre as stated in MS3:1979 or in the draft SS 26. In Singapore Standards for paints, only the contrast ratio is stated in the product specification.

Recommend to (1) adopt ISO 3906 to replace ISO 2814 for determining contrast ratio of paints and (2) specify the minimum value of contrast ratio for colours. It is noted, from Singapore's experience, most of the colours can show contrast ratio of 80 minimum. A few bright and saturated colours, such as signal red, canary yellow, lemon yellow, due its inherently transparent nature, can have a lower requirement, say, 75 minimum.

Clause 2.3.5 Resistance to wet abrasion

The requirement of 10,000 cycles is excessively stringent. A lower figure, say 3,000 cycles for exterior paint, will be adequate from our experience.

Recommend to change the requirement to 3,000 cycles for exterior emulsion paint and 1,500 cycles for interior emulsion paint.

Clause 2.3.7 Resistance to exterior exposure

It is not necessary to start the test between October and December, which is the wet season in Seychelles. For quality control purpose, the paint should meet the requirements irrespective when the test commences. For test cycle of 12 months, the paint panel will necessarily go through the rainy season.

Recommend to delete from G.2.2 the statement "The exposure shall commence between October and December".

Clause 2.3.9 Resistance to staining

Clause 2.3.10 Resistance to development of gloss

These clauses are apparently adopted from MS3:1979. Practical benefits of these test are not foreseen and have not formed part of the product requirements in Singapore Standard.

Recommend to delete these two requirements.

Clause 2.3.11 Resistance to fungal growth

Singapore experience has shown that disfigurement of exterior emulsion is associated with algal growth and not fungal growth. A Singapore Standard on algae resistant emulsion paint has been published to cater the need of the market. It entails higher material cost than ordinary emulsion paint and can be reviewed by SBS at an appropriate time later on. It will be a tall order to expect existing emulsion paint to meet with the requirement.

Clause 2.3.12 Water drop test

This test is presumably to check the water sensitivity of the emulsion paint, which is implicit in the wet abrasion resistance test. Thus a separate test for water sensitivity appears unnecessary.

Recommend to delete this test item as it appears redundant.

Appendix 4 Minimum quality attributes for emulsion paint and enamel paint

	Emulsion paint	Enamel paint
Batch No.	o	o
Condition in container	o	o
Viscosity	o	o
Fineness of grind	o	o
Density	o	o
Non-volatile content	o	o
Drying time		o
Opacity (contrast ratio)	o	o
Gloss, 85 °	o	
Gloss, 60 °		o
Washability	o	
Outdoor weathering - 1 year		
Surface defects	o	o
Gloss retention		o
Track record of use in Seychelles	o	o

O: Test to be conducted or record required

Appendix 5 Additional list of equipment - in order of priority

Name of Additional Equipment	Supplier & Catalogue No.
1. Film applicators, 50 & 75 μm wet film thickness, film width 90 mm	Erichsen Model 360
2. Film applicators for BK drying time recorder : 100 & 150 μm gap sizes cube film applicator, film width 16 mm	Sheen Ref 1103A
3. Wet film thickness gauge, wheel type, 0 - 250 μm	Erichsen Model 234
4. Film drawing assembly including polyester film and shims for preparation of paint film for measuring contrast ratio using the reflectometer	<ul style="list-style-type: none"> - Standard Plate Glass : Sheen Ref 1106A - 50 μm shims - 100 μm shims - Polyester sheets : Sheen Ref 1136 (1000 pcs/pkt)
5. Leneta charts (430 X 165 mm) for washability test to ASTM D2486	Erichsen Ordering No : 0070.01.32
6. A stand for flow cups including spirit level	Sheen Ref 418
7. Grind gauge, 0 - 50 μm	Erichsen Model 232, Ordering No : 0068.03.3
8. Four nylon brushes for washability test to ASTM D2486	Erichsen
9. Portable pH / temperature meter pH range : 0-14 Temperature range : 0-80 $^{\circ}\text{C}$	ATI ORION (USA) Cat. No. 0210A2 Complete with combination pH electrode Model 91-72
10. Toploading balance, precision 0.01 g, capacity up to 2 kg	Sartorius Model BA 2100S
11. Oven, forced convection type, room temp to 250 $^{\circ}\text{C}$, 53 litres	Memmert Oven Model 400
12. Mandrel bending tester conform to DIN 53152/BS 3900/ISO 1519	Sheen Ref 809
13. Electrical desiccator, latch door, horizontal design, 2 shelves, 450 x 330 x 255mm H	Elcometer (Asia) Pte Ltd, Singapore Model Auto A-3B (Code #0010)

Appendix 6 Review of record book for paint testing

Experiment records are primary source of information based on which a judgement will be passed as to the quality of the product under test. It is essential that validated procedures shall be followed in details; writing shall be unambiguous and legible and deviations from reference procedures shall be highlighted.

A6.1 General remarks

- a) Paginate record book.
- b) Sequence of date of experiment should follow that of page number of the record book.
- c) Do not erase data; strike off the incorrect data with a pen and rewrite the correct data by the side.

A6.2 Specific remarks

- a) Non-volatile content: Control the amount of paint weighed into the dish within the specification, about 2 g. A range of 3.1 to 8.6 g was found in the record. If the difference between two replicate readings exceeds one percentage point, repeat the experiment. Taking the average of two figures far apart is misleading.
- b) Gloss for enamel paint : Use 60 ° angle
- c) Gloss for emulsion paint : Use 85 ° angle
- d) For gloss and contrast ratio, it is not necessary to indicate decimal point in the final result.

INTRODUCTION

This report covers two weeks training attachment in Paint Technology at SISIR, Singapore by Nicholas Pothin, assistant general manager of Penlac paint factory.

OBJECTIVES

- a) Study and verify dosage and effects of additives in paints particularly anti settling, dispersing agents and driers.
- b) Quality control of raw material, in production and finished product control.
- c) Operation of high speed mixer and horizontal mill.
- d) Study colour matching technology in particular computerized spectrophotometer..
- e) Study treatment and control of effluent waste and undertake site visit.
- f) Discuss paint problems and attempt to find solutions.

DURATION

Two weeks - from 28th February 1994 to 12th March 1994.

The first week was spent at SISIR and the Federal Paint company of Singapore.

At Federal paint I was able to experience the actual manufacturing operations of the company and thus I was in a position to make comparisons with Penlac. I was very impressed with the emphasis put on quality control of raw materials. Although most tests were rather complex and necessitated sophisticated equipments some, however, like the oil absorption value of pigments are quite simple and could be introduced at Penlac. The efficiency and rapidity of the horizontal mill is most certainly advantageous when producing large volumes of paints. In production and finished product controls were both effective and very professional yet there again investment in equipments and staff training must have been substantial. The computerized spectrophotometer, although still at a very introductory stage at this company must certainly be a very valuable asset to the colour matching department yet any investment of this magnitude must be justified. The acute shortage of space to store raw materials is contagious to both Penlac and Federal paints.

The effluent control system at Federal, though simple appears to be very effective and could certainly be adapted and adopted at Penlac. Probably the most beneficial part of my spell at Federal paints were the numerous discussions I was able to have with members of the technical staff and to them I am very much indebted and grateful.

Federal's management has offered to assist Penlac source raw material requirements from Singapore, perhaps there could be some positive development in this area , in future.

At SISIR where I stayed much longer, I had some very enlightening discussions on the effects of anti settling and dispersing agents on paint. I was actually able to experiment and thus verify the effects of varying dosage of dispersing agent on the viscosity of the paint. I manufactured an alkyd black enamel on the laboratory's horizontal mill to evaluate the efficiency of this equipment and later varied the driers dosage to determine the corresponding effect on drying time. I also tried my hand at the oil absorption test of calcium carbonate and kaolin, the results were very interesting. Other quality control tests I was able to perform or verify were drying time of Singapore paints, fineness of grind, scrub resistance, measurement of specular gloss and opacity, adhesion and pencil hardness of epoxy paint, bend test, density and various viscosity measurements, accelerated weathering, corrosion and chemical resistance, outdoor exposure under humid tropical climate, biological resistance to fungal/algal growth, and colour measurement by computerized spectrophotometer. I was treated to a very informative tour of the polymer technology section. I remain appreciative of SISIR for allowing me access to their library where I was able to obtain very valuable informations on paint technology. My visit to the Technochem recycling plant was very interesting and educational.

Overall, I was both impressed and amazed by the high standard of technology and professionalism at SISIR. The very close working relationship they have with paint manufacturers is certainly of mutual benefits and must be advantageous to consumers.

CONCLUSIONS

- a) It is evident that stringent quality control of raw materials, in production and finished product control are conducive to good paint standard and subsequently consumer's satisfaction.
- b) Periodic updating in paint technology development is necessary.

RECOMMENDATIONS

- a) Both Seychelles Bureau of Standard and Penlac should work towards a common objective of ensuring that only good quality paint is supplied to the local market.
- b) Adequate laboratory equipment must be available at Penlac to enforce efficient quality control of raw materials, in production and finished product. Seychelles Bureau of Standard to complement when and where more complex tests are deemed necessary.
- c) More effective quality control of raw materials, in production and finished product should be introduced.
- d) Raw material suppliers should supply Penlac with appropriate technical specification of material supplied to verify consistency.
- e) Treatment system of raw water for emulsion paint production must be introduced.
- f) Prolonged storage of certain degradable raw materials must be avoided.

- g) Periodic evaluation of Penlac's paint performance must be carried out and when necessary formulation modification must be made.
- h) Improve raw material storage.
- i) More involvement of Penlac and Seychelles Bureau of Standard in surface verification of buildings before painting.
- j) Improve effluent control and disposal system.
- k) Increase staff training.

ACKNOWLEDGEMENTS

Seychelles Bureau of Standard for organising the visit, Penlac for the two weeks' release with financial assistance and UNIDO for sponsoring the trip. My deep appreciation and gratitude to the management and staff of SISIR and Federal paint for their cordial hospitality and valued assistance.

INTRODUCTION

This report covers two weeks training attachment in Paint Technology at SISIR (Singapore Institute of Standard and Industrial Research) by Eddy Sinon laboratory Technician of Penlac factory.

OBJECTIVES

- a) Familiarization of the equipment using in Paint Technology Standard Test.
- b) Able to conduct test on raw materials, Paint Product and semi-finished product.
- c) Use appropriate techniques to standardize Paint Product.
- d) Proper procedure to adjust viscosity using Ford Cup and stromer viscometer.

DURATION: Two weeks 4th April 1994 to 16th April 1994.

The two weeks was spent at SISIR, coating and surface formulation Laboratory where I was to experience the practice and facility used in Paint Technology.

I begun by learning how to prepare surfaces before applying paint, using tin, mild steel and glass plates. Method using burnishing, Polishing, Sanding, Abrasive blasting and cleaning with solvent (thinner). Then paint application using brushes and different applicator for different purposes.

I performed oil absorption test on some of the white pigments like TiO₂ and CaCO₃ etc. For comparing paints using Penlac's resin and Singapore's resin Alkyd two sample of Iron Oxide Gloss Enamel Red were manufactured, also to familiarize myself with the use of the Laboratory horizontal mill to determine the following tests.

- a) Fineness of grind before and after milling.
- b) Viscosity adjustment using Ford cup and stromer viscometer.
- c) Drying time using drying time recorder. Ballonti technique and hard drying time tester.
- d) Scratch resistance.
- e) Bend test.
- f) Opacity and Specular gloss measurement.

I varied the driers dosage to determine the drying time between Penlac's driers and Singapore's driers.

I also conducted other quality control tests on several Singapore's paint like adhesion and pencil hardness of epoxy paint, determine non-volatile content and volatile content of a product in percentage.

From Penlac I used Emulsion paint sample which I took to SISIR to find which is more resistance using wet abrasion test.

I was taken to a repainting site at Bedok BIK 201 and Yishun BIK 108 to see the following facility used by painter. I was impressed with the use of high pressure water jet to remove chalky, flaked paint and fungi growth. Gondola were used to lift workers up along the high building.

I had some very delighted observation at accelerated weathering, corrosion and chemical resistance, outdoor exposure under humid tropical climate, biological resistance to fungal/algal growth and colour measurement by computerized spectrophotometer. For my very interest in valuable knowledge in paint technology, I was allow to their library where I obtained suitable information for my personal research and reference.

SISIR is higher technological and very professional in their sector for better standard product control to satisfied consumer.

RECOMMENDATIONS

- a) Penlac is to be assist with technology and professional development in Paint Product.
- b) To maintain good quality of paint, standardization of raw material are necessary.
- c) Efficient laboratory equipment are needed to perform better test.
- d) More staff training.

Thanks to Seychelles Bureau of Standard, Penlac, UNLDO and SISIR staff for the hospitality and assistance in anyway.

TRAINING REPORT OF MISS VERONICA LABROSSE
TITLE: Training attachment in SISIR in Paint Analysis

Introduction

The training was organized during the visit of the paint consultant from UNIDO. Since some equipment had been installed in the Paint Lab and that I will be able to learn more about these instruments.

Arrival in Singapore

I was met at the Airport by the driver of SISIR and was taken to where I was going to stay for the two weeks.

The training was as follows:

On the 25th July, I went to SISIR and there I was met by Mrs Wong -Lin Tai Hoe. She took me to the Lab and once again I met the Lab staff. Later I went to see the director Dr. Loh Wah Sing and together with Mrs Wong we discussed the course content.

During the two weeks the Time Table was as follows :

Date	Test
25/7/94	Prepared test panel for -Scratch test . -Bend test . -Gloss test for enamel .
26/7/94	Prepared test panels for . -Scratch test . -Bend test for undercoat . -Gloss test . -Opacity test for emulsion . -Opacity test for enamel and undercoat .
27/7/94	Determination of -Non-volatile matter for emulsion . -Condition in container . -Prepared test panel for scrub test .
28/7/94	Determination of -Surface drying time for emulsion . -Hard drying time . -Viscosity (krebs storrer) . -Viscosity (Ford Cup) . -Calibration of krebs storrer viscometer .
29/7/94	Determination of -Non-volatile matter of enamel . -Prepared test panels for scrub test . -Calibration of Ford Cup .
30/7/94	Determination of -Density test . -Calibration of density cup .
1/8/94	Review of the first week training with Mrs Wong. Determination of

	-Dilution stability test . -Gloss test for enamel and emulsion . -Bend test for enamel .
2/8/94	Determination of -Drying time for enamel . -Fineness of grind .
3/8/94	Determination of -Non-volatile matter for undercoat . -Drying time for emulsion . -Density test .
4/8/94	Determination of -Opacity test for emulsion, enamel and undercoat.
5/8/94	Determination of -Wet scrub . -Flash point .
6/8/94	Review of the two weeks training with Mrs Wong and Dr Loh Wah Sing.

Details of course

Objectives: To train laboratory technician in the quality control of paints.

Subject discussed: The test methods for the analysis of emulsion, enamel and undercoat .

Method of Presentation: The course was in the form of demonstration of different test for emulsion , enamel and undercoat .

Conclusion

During the course, I was able to perform all the tests on the time-table. Now I am in a better position to carry out the tests in the Paint Lab .

Appendix 10 Review of SS26:1994 Revision 1, "Emulsion paints for interior and exterior use"

A10.1 Preamble

No attempt is made to review the quality requirements of the standard as it has been endorsed by the pertinent technical committee taking into consideration recommendations made during the first mission to Seychelles. The review is limited to those attributes which will pose conflicts of statements; where test methods are not clearly specified or incomplete.

A10.2 Product specification

Clause 2.1.4 Fineness of grind

Specify the requirement: 50 micron will be appropriate for emulsion paint. With the specification of fineness of grind, the requirement of coarse particles and foreign matter in Table 2 is not necessary. Refer to comments given in para 2.1.4 Appendix 2 of First Interim Report, Nov 1993.

Clause 2.3.4 Hiding power

Delete Table 1 as the contents are carried over from the old edition and they are irrelevant to contrast ratio.

Appendix F Resistance to wet abrasion

It is recommended to roughen the glass panel with carborundum powder before applying the undercoat. This is to form key for anchoring the paint to the substrate so that the paint film will not torn off during the scrubbing. The corresponding method in Singapore Standard is a useful reference.

Appendix G Resistance to exterior weathering

It is necessary to specify positioning of the test panel, e.g. 5° inclination and face the north.