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REHABILITATION OF LINDANE MANUFACTURING PLANT AT DURRES

SI/ALB/88/802

ALBANIA

Technical report: Findings and recommendations*

Prepared for the Government of the Socialist People's Republic of Albania
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Kishore Kumar,
consultant on anti-corrosion

Backstopping officer: B. Sugavanam, Chemical Industries Branch

United Nations Industrial Development Organization
Vienna

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* This document has not been edited.

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CONTENTS

REPORT ON THE RETURN MISSION

1.0 ABSTRACT

One detailed technical report by the author on his first visit of the split mission to the Durres Lindane plant, Albania, has already been submitted to UNIDO, which gives a detailed account of the process, the problems being encountered, problematic equipment, pipings, valves, fittings, causes, grey areas, along with overall assessment of the plant condition, and suitable recommendations.

The report is on the second visit of this mission, whereby the author joined the Process Expert (Mr. Vladimir Kopinich) at Durres between 16th June till 26th June, 89, and made an overall joint study and assessment of the whole situation from 'know-how', operational & maintenance aspects and have jointly examined the possibility of rehabilitating the lindane plant, and have jointly arrived at final conclusions, and offered joint recommendations.

The joint brief report & recommendations has been submitted to Mr. B. Sugavanam at UNIDO, Vienna on 28th June, 89 during our debriefing (annexure 1).

This is the second seperate report of the author on this issue outlining further observations made, the present state of affair as a result of joint review, final conclusions and recommendations.

This joint study and the complex analysis made on the process, plant equipment, operational and maintenance aspects, etc. has resulted into a new scenario that, in reality, the 'know-how' presently available with them is not adequate to achieve the desired yield of pure lindane at the required capacity, and that the rehabilitation is almost neither possible nor advisable. This has posed a major question, whether it is worth considering rehabilitation of the present plant.

2.0 THE RETURN MISSION

As a part of the split mission, the author was advised by UNIDO to undertake a second visit to Albania in order to carry out a joint assessment of the Lindane plant at Durres along with the other UNIDO Process Expert, Mr. Vladimir Kopinich, so as to arrive at complete and commonly agreed conclusions and after recommendations in totality. Accordingly the author proceeded to Durres, Albania, after briefing at Vienna, and joined the process expert between 16th to 26th June, 89 at the fag end of his stay.

The author's total period of this return mission was from 13th June, 89 to 2nd July, 89, the actual stay in Durres being from 16th June, 89 to 27th June, 89.

3.0 OBJECTIVES

The main objective of this return mission was to make a joint study and complete assessment of the whole plant from operational, maintenance, corrosion, equipment condition points of view, and to arrive at final conclusions and to offer final recommendations, in totality, keeping in mind the overall economics, on the possibility of rehabilitation/modernization of the Lindane plant.

4.0 REFERENCE TO THE FIRST REPORT & ITS COMMITMENTS

The author's first report gives a wide coverage of all the required basic information, process description, various corrosion problems being encountered in the lindane plant, identification of problematic equipment, several grey areas needing improvements, maintenance aspects, identification of equipments needing replacements, recommendations on the right material of construction, causes, overall assessment and findings, and finally recommendations on replacements, measures for improvements, and other protective measures.

It is not, therefore, intended to repeat all this again in this report, and the first report can be referred for all such basic & valuable information and for the author's independent assessment and recommendations.

As per the commitments made in the first report, the author is pleased to enclose the following documents, which will be very helpful to the maintenance group of the lindane plant. (A complete set of these procedures has already been handed over by the author to the Lindane plant, Durres)

i) Welding procedure for S.S. pipe to pipe butt weld joint (Annexture-II)

ii) Welding procedure for S.S. pipe to nozzle fillet joint (Annexture-III)

iii) Repair procedure for damaged glass lining. (Annexture-IV)-Page 1 to page 4.

iv) Procedure for application of special anti-corrosion H.B.P.V. paint. (Annexture-V)

v) List of parties supplying PTFE/PVDF lined equipment/pipes/fittings. (Annexture-VI)

vi) List of manufacturers/suppliers of Hestelloys pipes/fittings. (Annexture-VII)

vii) Name of parties/fabricators for Tantalum lined equipment. (Annexture-VIII)

viii) Names of glass lined equipment manufacturers.
(Annexure - IX)

ix) List of parties supplying ultrasonic NDT instruments.
(Annexure - X)

x) Addresses of parties supplying D.P. Test Kit.
(Annexure - XI)

xi) A small write-up on 'TIG' welding process for S.S.
(Annexure - XII)

Note: The author is unable to recommend any treatment programme for the cooling water system, since the circulating water analysis was not made available, even during this second visit and in-spite of many reminders.

5.0 FURTHER OBSERVATIONS & FINDINGS (A NEW SCENARIO)

5.1 The basic'know-how' for the lindane plant was from China but without any formal contract between people's Republic of China and Govt. of Albania. As the relation between the two countries got severed by 1982 and the technical cooperation between the two got discontinued, the further basic and detailed engineering was done within the country, mainly by a small group of people at the Institute of Chemistry, Tirana. With the result, the process technology as well as designing and fabrication of various important process equipment(excepting the main enamelled reactors, which were supplied by Chinese) were simplified, which do not really match with the original 'know-how' intended by the licensor. As a result, the present technology/know-how available, in reality, with the lindane plant does not allow them to produce pure lindane (99.5%), and to the required capacity.

5.2 It thus appears that, in reality, the lindane plant does not have a 'know-how', which can give the desired yield of pure lindane at the required capacity, and also the 'know-how' presently available with them does not provide a sufficient base either for basic & detailed engineering or for rehabilitation.

5.3 An altogether new scenario has now thus emerged out as a result of process experts' in-depth study of the process, and further joint review of the whole situation, in totality, that any rehabilitation of the lindane plant in its present state of affairs, almost looks impossible, highly uneconomical, and impractical. The process expert, Mr. Kopinich, will discuss the process and know-how in greater details in his independent report.

5.4 In the light of the above, it has now become a big question mark whether it is at all worth investing huge sum of money in the replacements of so many corroded and damaged equipment, piping and fittings, as identified and listed, in the author's first report. Perhaps not.

5.5 Any decision on the question of rehabilitation of the present lindane plant has to be taken most carefully and judiciously, and the decision should be left completely on Albanian authorities, as any attempt to rehabilitate is not only going to be a difficult and highly expensive affair, it will also not guarantee the desired results, as there are also several others in-built problems and constraints in the lindane plant related to operational and maintenance skill, quality of personnels associated with it, the work culture and work behavioural aspects, preparedness to handle day-to-day plant and maintenance problems etc.

5.6 The overall situation at the lindane plant, both from operational and maintenance aspects, is highly unsatisfactory, and is a matter of great concern, as there is not going to be an easy, simple and straight solution to this complex problem.

5.7 In general, the state of health of majority of the equipment, pipings and fittings etc are very poor, and their reliability is almost lost, due to high level of internal and external corrosion, lack of operational and maintenance skills and preparedness, and absence of systematic preventive maintenance of mechanical, electrical, and process instruments, absence of predictive inspection and corrosion control programme.

5.8 Even though the process and the service conditions in the lindane plant is highly corrosive, corrosion could certainly be considerably reduced, if not eliminated, by using the right construction materials, good welding and repair procedures, by adopting good maintenance and inspection practices, by following a well-knit programme of equipment condition monitoring and corrosion control.

5.9 In general, the organisation of maintenance and operation groups does not meet the requirements of the complex process and the demands of the plant situation. The quality of both the groups need to be upgraded.

5.10 The maintenance team,in particular, at the lindane plant, needs much greater attention as the maintenance group is not geared up even to attend to the routine, minor maintenance & repair jobs, what to say of predictive & protective maintenance. This group need to be strengthened, and brought to a state of higher skill & efficiency, in the areas of maintenance of mechanical, electrical, and instruments.

5.11 There is also no safety consciousness, no proper means of handling solid, liquid waste disposals, there being lack of awareness and appreciation in the areas of housekeeping, 'on-stream' inspection, quality control, corrosion control, condition monitoring, cooling water treatment, protective paintings etc.

5.12 There is also, in general, in the lindane plant a requirement of inculcating a result-oriented work culture, a sense of responsibility, and a system of accountability. A comprehensive training in these aspects would also be advisable as it is ultimately the people, who operate and maintain the plant, and on whom the plant performance depends.

5.13 To help lindane plant to improve their maintenance group and to have an useful and impressive maintenance information system, a complete set of the following blank & printed proforma, to be used for effective recording and documentation, has been handed over by the author to the maintenance group(Mr.Edward Malltezi).

i) Format for examination of pressure vessel
ii) Hydrostatic test certificate.
iii) Welder's Test Certificate
iv) Kardex cards for equipment data & inspection history(5)
v) Daily communication slip.
vi) Radiographic Report format.
vii) Format for Welding procedures.
viii) Inspection note for internal communication.
ix) Shutdown Inspection note.
x) Inspection request form (work order)
xi) Job completion certificate.

5.14 The possibility of deploying zinc sacrificial anodes for the cathodic protection of C-steel exchangers, as well as use of process corrosion inhibitors was reviewed by the author with the process expert, and it was finally agreed not to go for these, as in the opinion of the process expert the same need not be experimented since he himself did not have definite experience of having no adverse effect of these in the process lindane manufacturing.

5.15 There is no practice of analysing and treating the cooling water for controlling corrosion. The fact that cooling water is a highly corrosive fluid need to be appreciated, and an effective/regular cooling water treatment programme should be followed.

5.16 There is also no practice of protecting the costly and critical equipment from external corrosion, and a regular protective painting programme with the right type of protective coatings & procedures, as recommended, must be followed.

5.17 Good welders need to be trained and kept in regular practice, and the correct welding procedures, electrodes, for welding stainless steels etc., as recommended, with good welding supervision, should be used with adequate means to check the weld quality, otherwise the present state of frequent weld failures/ leakages would continue.

5.18 Any handling and repairs of glass linings must be done delicately and most carefully and procedures, so recommended, should be adopted. However, the condition of the present glass linings being so bad(full of cracks), that any such repair is not going to be full proof.

5.19 The quality of the glass linings of the main enamelled reactors is not known, and no test certificates/documents available. In view of the nature and degree of damages, the problems experienced in repairing, its condition as inspected by the author in his last visit, the quality of the linings, as supplied, is in all probability, not of first class quality.

5.20 In seperate meetings with committee of Science & Technique, Tirana, the higher management(Director) of Durres plant, the Institute of Chemistry, Tirana, as desired by them, we have verbally informed and fully appraised them on our observations, findings, and our line of thinking on possible measures that can be taken.

IMPORTANT NOTE

The above observations should not be regarded as criticism, and it should rather be taken in the right perspective. These are being highlighted with noble intention and in the overall interest of the lindane plant, as unless the weaknesses are brought out by an independent agency such as UNIDO, the scope of improvements can not be defined.

6.0 FINAL CONCLUSIONS

The conclusions finally arrived at, after the second visit of the return mission and after further joint reviews, and discussions with the process expert, Mr. Vladimir Kopinich, are summarised below ;

6.1 A brief joint report, along with the process expert, (annexure-I) has been submitted to UNIDO, Vienna, on 28-6-89 during our debriefing with Mr. B.Sugavanam.

6.2 The author's conclusions and recommendations as regards identifying problematic equipments, need of equipment replacements etc., theoritically remain the same as listed in annexure II A & B of the author's first report, from the point of view of rehabilitation of the plant.

6.3 However, the conclusions of the process expert have now given an altogether new direction, by virtue of which the basic issue of rehabilitation itself has become questionable, whether it is, at all, worth investigating all that money in rehabilitating the existing plant.

6.4 The conclusion of the process expert, that the plant does not have a 'know-how' to produce pure lindane of required quality & quantity and that no amount of equipment replacements, in its present state of affair, would guarantee the production of the required yield of pure lindane at the desired capacity, has led every one to think of a new plant with complete know-how. A critical, careful and most judicious decision is, thus, required to be taken.

6.5 Whether rehabilitation or a new plant, as it is ultimately going to again depend upon the quality of people who are going to operate and maintain the plant, and on whom ultimately the fate of the plant would rest, it should be equally important to develop, strengthen and upgrade their skills, and work culture, by vigorous schooling and training, and the required awareness and preparedness ought to be brought, more so, in the area of maintenance, and also all the various steps, as recommended by the author in his first and second report, ought to be sincerely and religiously adopted.

6.7 Any rehabilitation of the lindane plant, in its present state of affair and in absence of a 'know-how', will not only mean replacements of so many equipments, pipings, fittings, it will also mean redesigning and adding some major process equipment to match the originally intended know-how, apart from taking several other measures and training programmes, as recommended. It will obviously lead to expenditures of huge sum of money.

6.8 FOR BETTER PLANT PERFORMANCE :

With the improved repair procedures and maintenance practices as recommended, with regular and the right type of protective painting programmes as advised, by replacing only the few most essentials, as per priority given in the author's first report installing couple of essential process instruments as advised by the process expert, improved analytical facilities, with regular cooling water treatment programme, by adopting safe practices and using safety appliances, by using couple of NDT monitoring instruments, etc., the lindane plant can perrorm better than what is performing now.

7.0 FINAL RECOMMENDATIONS

7.1 Any Rehabilitation of the Lindane plant with its present state of affair, and in absence of a full proof know-how, which will not only require huge investment, which may also not give guaranteed results, may not be recommendable. The overall economic analysis may not favour rehabilitation.

7.2 It is recommended to go for a new Lindane plant on a turnkey basis by inviting quotations and offers for know how of the process, machinery, equipment, and construction from the reputed Lindane manufacturers and equipment suppliers.

7.3 A less expensive alternative would be to borrow process know how, machinery, equipment and basic engineering from other countries, and indegeneous detailed engineering, and construction including assembly. This will, nevertheless, have certain amount of risk mainly at the stages of detail engineering and construction. This alternative should be considered keeping in view the indegeneous capabilities and the risk involved. This decision should be left to the Government of Albania.

7.4 With improved repairs and maintenance system, good protective painting programme, regular treatment of cooling water, equipment condition monitoring programme, some modifications, use of correct construction material, partial replacements, and inclusion of missing additional equipment, improved man power quality etc., the performance can also be improved to some extent. It should however be made clear that this will not be a full proof proposal, and will not guarantee a regular production of pure Lindane, but only a concentrate with high Gamma Isomer content, within certain capacity limits i.e. 30-50 tons per year. This will, however, call for a thorough investigation on the indegeneous capabilities concerning additional research, engineering, machinery procurements, and the organising competency required for construction. Any way, quotations and offers for most important items of machinery will be necessary, such as a system of chlorination reactors, granulation and drying equipment, seperation equipment, and several others. It can thus be seen that this alternative will also by no means be an inexpensive proposition.

7.5 During the period of preparation and the construction of a new Lindane plant, the following activities/consultancy services can be assisted by UNIDO consultants, by a mutual agreements between UNIDO & Government of Albania.

7.5.1 Formulation of engineering for inviting quotations and offers, for a turnkey plant or individual machinery and equipment.

7.5.2 Evaluation & Selection of the recommendable quotations and offers.

7.5.3 Auditing and Design review of the basic and detail engineering.

7.5.4 Monitoring and consultancy at the decisive stages of construction on the site.

7.5.5 Plant construction commissioning assistance.

7.5.6 Schooling & Training of the plant staff of all disciplines.

7.5.7 Technical assistance during the plant start-up period.

7.5.8 Evaluation of plant performance at the end of one year operation and offer suitable suggestions for improvements.

7.5.9 Periodical reviews of operational and maintenance activities, and offer suggestions for their optimisation.

7.6 It would be advisable to impart locally short term and long term schooling and training, with the help of 5-6 UNIDO experts, in several disciplines/areas of importance, necessary to develop the plant personnels, bring awareness and preparedness, such as;

* Operational skill.
* Maintenance management.
* Predictive Inspection & condition monitoring.
* Inspection practices.
* Safety & House Keeping.
* Corrosion Science & Engineering.
* Managerial skill and leadership.
* Performance Appraisals & Accountability.

8.0 ACKNOWLEDGEMENT

The author wishes to acknowledge his gratitude and sincere thanks to the United Nations Industrial Development Organisation for giving this opportunity of serving UNIDO & Govt. of Albania in the capacity of UNIDO Expert.

The author is also very thankful to Govt. of Albania and the management of Lindane plant and the chemical enterprise, Durres, for extending all co-operation and assistance, which have been extremely helpful in accomplishing the task.

The author is highly grateful to his parent organisation M/s. Indian Petrochemicals Corporation Ltd., Baroda, India and the Govt. of India for having granted permission to him to take up this UNIDO assignment.

BRIEF JOINT REPORT BY :

KISHORE KUMAR & VLADIMIR KOPINICH

REHABILITATION OF LINDANE MANUFACTURING PLANT, DURRES, ALBANIA.

JOINT SUMMARY CONCLUSIONS & RECOMMENDATIONS.

Main observations, conclusive remarks and recommendations offered jointly by the two UNIDO Experts ;

1.0 INTRODUCTION :

Our following observations and overall conclusions are based on a complex analysis of process, all the equipment, and the present state of affairs that exist in reality at the Lindane plant. These are based on a limited and partial study and review of the entire operational and maintenance aspects of BHC & Lindane plant, as also the plants were not in full operation throughout our stay here. Our work was further limited due to several constraints such as absence of required documentations, operational and analytical records, history of plant operation, and other necessary technical information.

2.0 OVERALL CONCLUSIONS ON THE PRESENT STATE OF AFFAIRS :

2.1 The original technological process was supposed to be on the process license from the Chinese People's Republic. However, as the technical cooperation between the two countries subsequently got interrupted and also as there was no formal contract signed between the two countries, the technology and the further detailed engineering was accomplished with the country mainly by the Institute of Chemistry, Tirana. With the result, the technological process as well as the process equipment was simplified, which do not really match with the requirements of original technology intended by the Licensor. The present technology and the equipment and machinery do not allow to produce final product with quality parameters to the requirements of pure Lindane (99.5%-W.H.O.), and to the required capacity.

2.2 Under the circumstances, where all the main enamelled reactors were supplied by the Licensor, some valuable process equipment were, however, procured by the user/local plant management. Also, in the author's opinion, the enamelled reactors and the armature, so supplied, are not of guaranteed first class quality.

2.3 The overall situation at the Lindane plant, both from operational and maintenance aspects, is highly unsatisfactory, and is a matter of great concern, as there is not going to be a simple and straight solution to this complex problem.

2.4 In our opinion, the overall state of health of majority of the equipment, pipings and fittings etc. are very poor due to the high level of internal and external corrosion, lack of operational and maintenance skills, and absence of systematic preventive maintenance of mechanical, electrical, and process instrumentations.

2.5 Even though the process and the service conditions in the lindane plant is highly corrosive, corrosion can certainly be considerably reduced by using the right construction materials, adopting good inspection and maintenance practices, by formulating and following a well-knit programme of equipment condition monitoring and corrosion control.

2.6 Due to the exacting technology and machinery requirements, it is an absolute necessity to achieve a state of basically higher work organisation and efficiency in all fields of activities like operation, maintenance, analytical and corrosion control.

2.7 It would appear from the facts stated above that, in reality, the 'know-how' presently available with them is not adequate to achieve the desired yield of pure lindane at the required capacity and is also not a sufficient base neither for basic and detailed engineering nor for rehabilitation.

3.0 RECOMMENDATIONS :

In its present state of affair at Lindane plant as described above, and appreciating the above conclusions that under the circumstances, rehabilitation of lindane plant, so as to full fill all the requirements of a modern, efficient and an economically working plant, will not be possible, we suggest the following alternatives;

3.1 It is recommended to go for a new Lindane plant on a turnkey basis by inviting quotations and offers for 'know-how' of the process, machinery, equipment and construction from reputed Lindane manufacturers and equipment suppliers.

3.2 A less expensive alternative would be to borrow process 'know-how', machinery, equipment and basic engineering from other countries, but with indegeneous detailed engineering and construction including assembly. This will, nevertheless, have certain amount of risk mainly at the stages of detailed engineering and construction. This alternative should, therefore, be considered carefully keeping in view the indegeneous capability and the indicated risk. The decision must be left completely to the Albanian authorities.

3.3 Though, it is not our recommendation, some modifications, partial replacements, and inclusion of few missing equipment and adding some additional equipment can be considered. It should, however, be made clear that this will not be a full-proof proposal and will not guarantee a regular production of pure lindane but only a concentrate with high gamma isomer content within certain capacity limits, say, 30-50 tons/year. This will also call for a thorough investigation on the indegeneous capability concerning additional research, engineering, machinery procurement and the organising competency required for construction.

In any way, quotations and offers for most important items of machinery and equipment would be necessary such as a system of chlorination reactors, granulation and drying equipment, seperation equipment and several others. It can thus be seen that this alternative will also, by no means, be an inexpensive proposition.

3.4 During the period of preparation and the construction of a new lindane plant, the following activities/consultancy services can be assisted by UNIDO consultants, by a mutual agreement between UNIDO and Government of Albania.

3.4.1 Formulation of enquiries for inviting quotations and offers for a turnkey plant or for individual machinery and equipment.

3.4.2 Evaluation and selection of recommendable quotations and offers.

3.4.3 Auditing and design review of the basic and detailed engineering.

3.4.4 Monitoring and consultancy at the decisive stages of construction on site.

3.4.5 Plant construction commissioning assistance.

3.4.6 Schooling and training of the plant staff of all disciplines in several areas of importance.

3.4.7 Technical assistance during the plant start-up period.

3.4.8 Evaluation of plant performance at the end of one year operation and offer suitable suggestions for improvements.

3.4.9 Periodical reviews of operational and maintenance activities and offer suggestions for their optimisation.

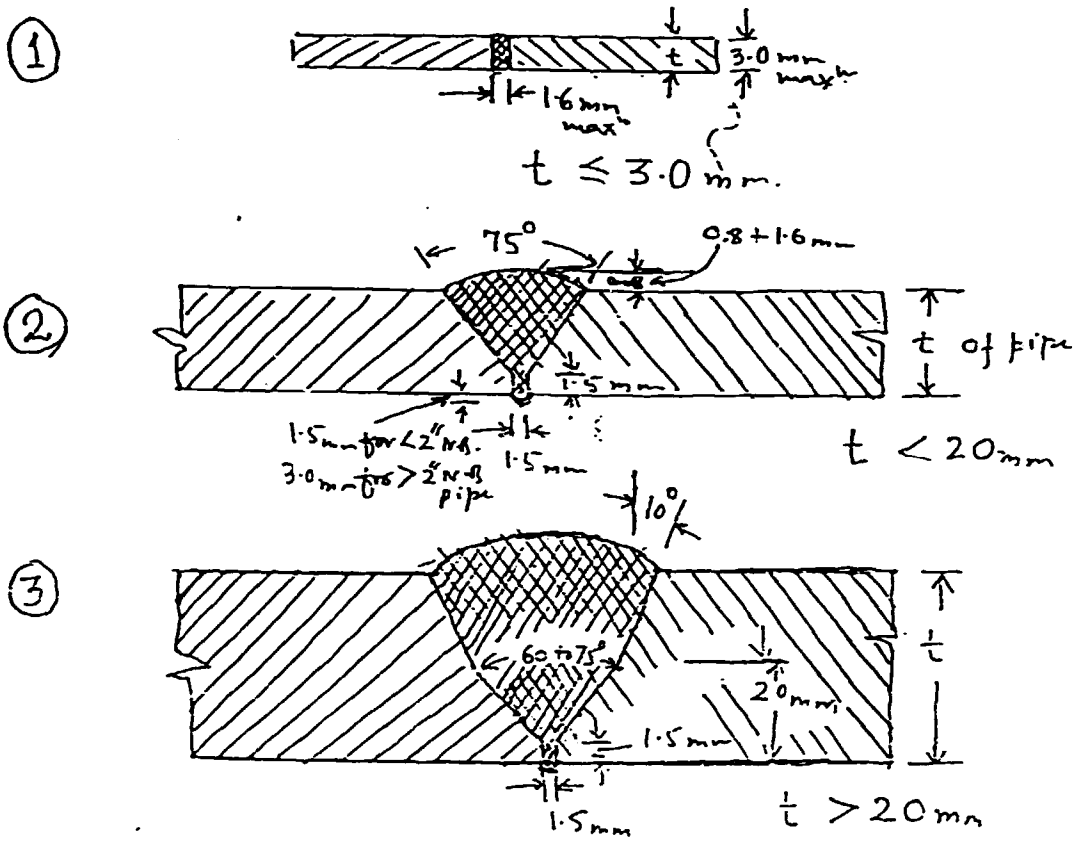
3.5 The present worldwide situation of Lindane is very uncertain, even though lindane is very valuable instecticide,manufacture at the large scale would create toxic side products, unwanted isomers which in the long run could pose problems of storage and disposal. So any new technology should take into account conversion of side products to usable chemical intermediates.

3.6 Albanian Government should also take into account another alternative of investing money for the production of safer and more valuable pesticides useful to Albania rather than spending money on one product dedicated plant for the production of lindane. The recent trend is to go for multipurpose pesticide plants using batch processes rather than, one product dedicated plants.

ANNEXURE - II

PIPE TO PIPE BUTT WELD JOINT (Single Side Weld)

WELD CONFIGURATION :



WELD ELECTRODES FOR S.S. WELDING :

	MMA			TIG			REMARK
	SS 304/304L	SS 316/316L	SS 321	SS 304/304L	SS 316/316L	SS 321	
Electrodes AWS SPEC.	E 308L	E 316L	E347	ER 308L	ER 316L	ER 347	Argon purge in pipe is necessary in case of TIG weld.

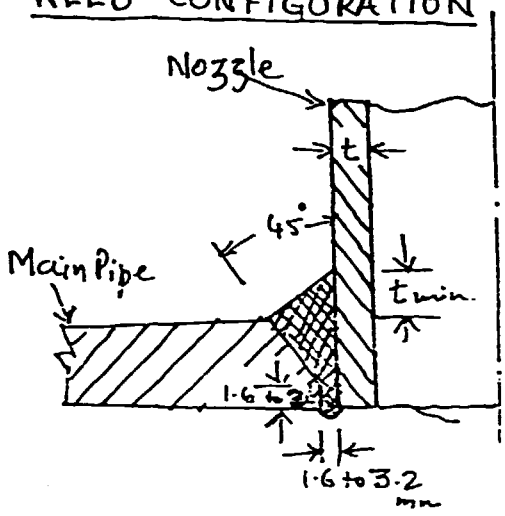
NOTE :

* Weld Procedure Specification(WPS), procedure Qualification Record (PQR) and welder performance qualification(WPQ) are necessary before taking up job.
* Set up inspection, Root and Final run D.P. test, Radiography, Hydrostatic test at 1.5 times design pressure and Heat treatment/ solution annealing in case of SS 304, 316
* In the case of accessibility of otherside and in the event of irregular root penETRATION, BACK CHIP FOLLOWED BY WASH RUN ON Other side is necessary.

ANNEXURE-III

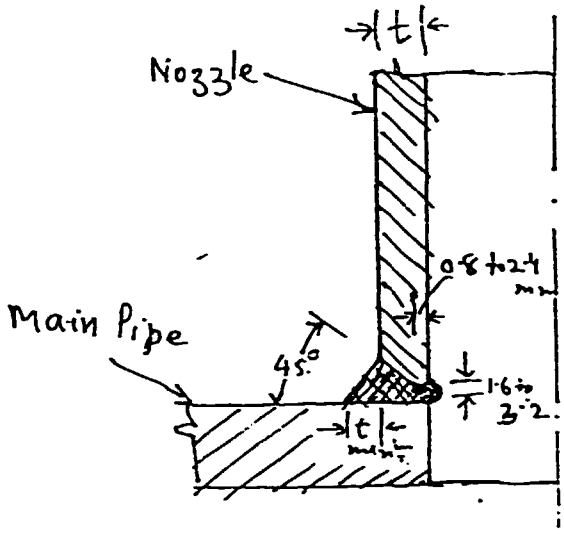
PIPE TO NOZZLE FILLET JOINT

WELD CONFIGURATION



STUBIN TYPE

OR



STUBOUT TYPE

WELD ELECTRODES FOR S.S. WELDING

	MMA			TIG			REMARK
	SS 304/304L	SS 316/316L	SS 321	SS 304/304L	SS 316/316L	SS 321	
Electrodes AWS SPEC	E 308L	E 316L	E347	ER 308L	ER 316L	ER347	Argon purge in pipe is necessary in case of TIG weld.

NOTE :

* Weld procedure specification (WPS), procedure Qualification Record (PQR) and welders performance Qualification(WPQ) are necessary before taking up job.
* Set up inspection,
* Root run & Final Run D.P.,
* Hydrostatic test at 1.5 times design pressure,
* Heat treatment/solution annealing in case of SS 304/316; are necessary depending on service conditions.

ANNEXURE - IV

GLASS LININGS-REPAIR

* Mechanical stresses : Any type of stress resulting is indusing tensile stress on the interface is harmful for the glass lining. The major sources being tightening of clamps, vibration or misalingnment of agitator shaft, stresses due to expansion contraction of the jacket on the shell etc. Most of these causes can be taken care by better maintenance and proper design.

Cavitation : If the agitator is running at a very high speed, the cavity is formed at the area opposite to movement agitator blades. The presence of air babble tend to chip off the lining in that area.

REPAIRING OF THE DAMAGED GLASS LINING

The damaged lining should be repaired. The repair procedure depend on the extent and size of the localized damage while if the thickness of glass lining is reduced considerably in the relatively large area, then it is not possible for site repair. Relining of glass is necessary which can be carried out only in shop floor, using the same procedure described earlier. Any equipment can be relined by glass for maximum 3 times than it is recommended to discard. Local field repair can be devided in main three catagories.

1. Repair by cement or resins
2. Repair by metal plug or plate.
3. Repair of nozzles.

Repair by resin or cements :

Several types of cements can be used for repair. However their use are restricted because of main disadvantages of poor mechanical strength, lack of corrosion resistence and ability withstand temp. Use of some cement manufactured by M/s. Shinko Phaudler is described below :

* 54 resin :

This epoxy based resin mainly used for very mild corrosive service.

* Alchore cement :

This is silicate cement consisting of hardner and cement powder. These are mixed in the ratio of 1:2.

This has somewhat corrosive medium. The cured cement needs pickling by 50% H_2SO_4 and then rinse with water. Sometimes a coat of furan base cement is also applied to protect the Alchore cement. AFT cement. It is pre-blended cement and dispersing agent. The application can be done by brush having maximum thickness as .3 mm/coat. This is mostly suitable and used for rectification of gasket faces of nozzles.

As per recommendation of M/s. Shinko Phaudler all these repairs by cement should be restricted to any gas phase and the repairs shall be regularly checked once in a week. Maximum storage life of all such cements is hardly one year.

Repair by metal plug/plate :

Small area of damage on G.L. are repaired by using a metal plug. The most commonly used metal for the plugs is Tantalum. The other materials which are also used, are stainless steel, Hastelloy Titanium, Zirconium etc., but for the main three reasons Tantalum is extensively used.

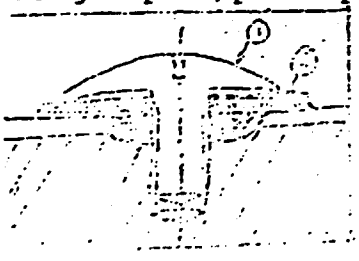
* Better corrosion resistence
* Easy for working
* Thermal expansion is almost equal to the glass.

The choice of method for repair mainly depends on the size of damage. The damaged surface must be ground and the damaged area should be thoroughly cleaned. The working temperature should be lower than the heat resistant temp. of PTFE gasket and the cement used for repair in order to allow the perfect sealing.

The area of repair is restricted upto max. 20mmØ. For the size higher than this, the guaranteed sealing is difficult.

The typical methods of repair are given below :

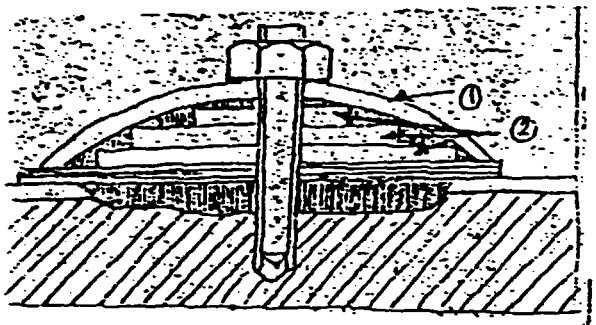
* Plug repair/piece plug



- A single plug in the form of round headed screw is screwed in the drilled and tapped hole exactly at the spot of damage.

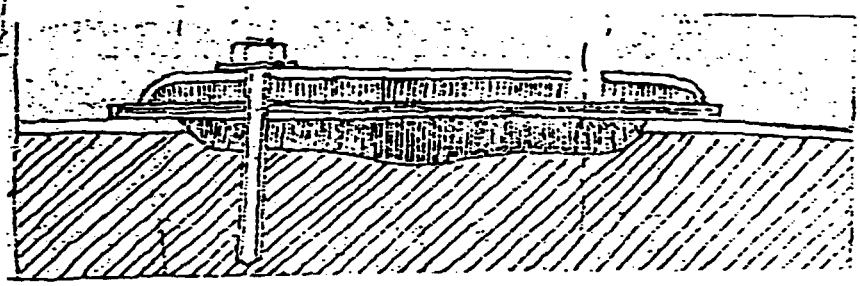
Size limitation for this type of plugs as 13 to 25 mmØ and generally used for the defects like pin holes etc.

Disc repair / 5 piece plug.



This is used for slightly larger area, max. upto 60 mmØ, can be repaired by this method. For disc having Disc more than 40 mm, leathany teflon packings are used, in the follow portion.

Plate repair



This method is employed when the area of damage is more than 60 mmØ/ or in irregular shapes. Maximum upto 200 mmØ areas have been successfully repaired by this method put for high size guaranteed sealing is not achieved.

Repairing by metal plug/plate is a skilled job. No way of checking the perfect sealing is available. It is advisable to open the equipment and check the equipment repaired area visually after operation of a week. All these repairing methods are suitable where working can be done confortably. But in case the area in the nozzle is damaged, then repair using such methods is very difficult since no proper drilling and tapping can be done. For the nozzles having dia more than 4" such repairs have been done by M/s. Shinko Phaudler using a special attachment for drilling/tapping but for the nozzles less than 4" Ø the repair is very critical few methods are described below.

(i) Blind type :

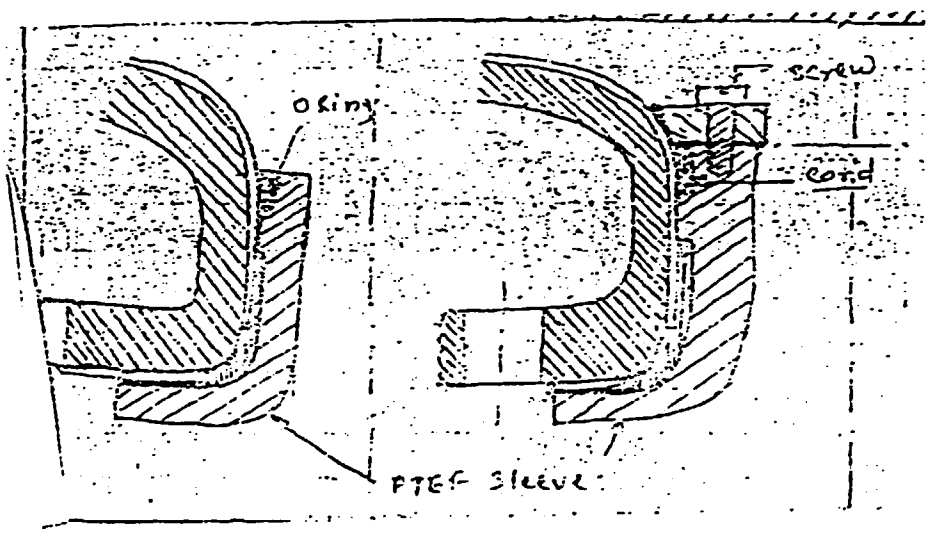
The damaged nozzles can be blinded with the type of repair. The material of construction of the blind plate should be very carefully selected depending on the service of equipment.

(ii) Sleeve type :

This an improved version of the blind type (i) having a sleeve to allow the discharge of the fluid. The material of construction is to be decided depending on the service fluid.

(iii) Repair by Teflon sleeve :

This method is used for the damage near the flange of the nozzle but the limitation of pressure and working temperature of equipment below the working temperature of PTEF. The sleeve is manufactured from the solid teflon rod and fixed in the nozzle. The sealing at the lower (open) end can be achieved by O'ring or cord as shown in the sketch.



ANNEXURE - V

PROCEDURES FOR APPLICATION OF SPECIAL PAINT SYSTEMS(HIGH-BUILD EPOXY AND HIGH-BUILD POLYURETHANE).

* The most important step for any good painting job, is surface preparation. Good surface preparation will ensure proper adherence of the paint system onto the surface being protected by paint. Good surface preparation, under ideal conditions, will entail complete absence of any old paint, rust, dust, oil grease or any such other contaminants on the metal surface. The steel surface must be visible in near-white colour only. This can be achieved by method like sand-blasting. If paint is applied on a surface prepared this way, maximum protection and life may be expected from the paint applied.

  However, in running plants, it may not be practically possible to employ surface preparation by sand-blasting and in such situations, manual mechanical cleaning using hand tools like scrappers, wire brush, emery paper, etc. is to be employed. It must however be ensured that all loose rust, dust, old paint and other contaminants are completely removed. In other words, even when compromise is made and manual cleaning is done, it must be ensured that even after applying all the above-mentioned hand-tools, practically nothing comes off from the surface.

* After surface preparation is done thoroughly by the methods described above, next step is to apply primer on the prepared surface. The caution required is that the priming must be done immediately after surface preparation is over(say within 2 to 4 hours). Otherwise, the prepared surface may get deteriorated by re-rusting, etc. This is to be particularly observed when surface preparation is done by sand-blasting.

  The primer must be applied as a thin, uniform layer. Typical dry film thickness of a primer coat is about 20-25 microns. Sometimes, when surface preparation is done by sand-blasting, two successive primer coats are required to be applied for obtaining optimum effectiveness. The primer coat normally requires minimum 8 to 12 hours for drying, and subsequent coats are usually applied 24 hours after applying the primer coat.

* 24 hours after applying the primer coat, the first coat of paint is applied. Again uniform coat must be applied maintaining proper film thickness of paint. The thickness of the dry paint film will actually depend on the type and grade of paint applied. The paint manufacturers' guideline in this regard must be adhered to for proper performance of the paint system. Typically, the dry film thickness of the first coat of high-build polyurethane is 30 to 40 microns, while that for high-build epoxy is about 100 microns. The first paint coat will normally dry in 8 to 12 hours for most grades of H.B.P.U. and H.B. Epoxy. The second paint coat is usually applied 24 hours after the first coat.

(..2..)

In practically every painting system/programme, two consecutive finish coats are applied over the primer coat (instead of a single coat giving the same thickness). The second coat is applied usually 24 hours after applying the first coat as described above. The dry film thickness of second coat is usually the same as that for the first coat.

* After the final coat(the second coat) is applied, the complete coating system is to be cured fully for about 7 days before it is put into service. During the curing period no water or other contaminants like oil etc must come in contact with the paint.

* All the above mentioned stages of painting must be inspected regularly to ckeck that they are followed adequately. Then only the quality of job will be ensured and optimum expected results will be obtained.

ANNEXURE - VI

LIST OF PARTIES FOR PTFE/PVDF LINED EQUIP. & FITTINGS

(1) M/S. PENNWALT CORPORATION
3 PARKWAY,
PHILADELPHIA, PA-19102
U.S.A.

(2) M/S. AMETEK HAVEG DIV.
900 GREENBANK ROAD,
WILMINGTON, DE-19808
U.S.A.

(3) M/S. AUSIMONT
44, WHIPPANY ROAD,
MORRISTOWN, NJ 07962

(4) M/S. HITEMCO
160-T SWEETTHLLOW ROAD,
OLD BETHPAGE, NY-11804

(5) DU PONT CO.
COMPOSITES DIV.
EXTERNAL AFFAIRS DEPT.,
NA-226, 1007 MARKET ST.
WILMINGTON-DE 19898

(6) FLUORO CARBON
POST BOX 15639
HOUSTON, TK 77220
U.S.A.

(7) MADRAS INDUSTRIAL LINING LTD.
425, PANTHEON ROAD, EGMORE
MADRAS-600 008.

(8) M/S. RESISTOLINE(I) PVT.LTD.
607, ROHEJA CHAMBERS,
213, NARIMAN POINT,
BOMBAY-400 021.

(9) PENWALT INDIA LTD.,
507 KAKAD CHAMBERS,
132, DR. A. BESANT ROAD,
WORLI, BOMBAY-400018.

ANNEXURE - VII

(B) MANUFACTURERS/SUPPLIERS OF HASTELLOYS PIPES/FITTINGS :

(1) CABOT ALLOYS U.K. LTD.,
EARLSTRESS ROAD,
CORBY, NORTHANTS
NN17 2AZ ENGLAND TELEX: 341674

(2) WIGGIN ALLOYS GMBH
D-4000 DUSSELDORF 1,
W. GERMANY

TELEX: 8587768

WIGGIN ALLOYS LEU WORKS
LEU BROOK ROAD,
WEDNESBURY,
WEST MIDLANDS WS 10 7 LD
U.K.

TELEX: 337535

(3) INCO ALLOYS INTERNATIONAL INC.,
HUNTINGTON,
WEST VIRGINIA 25720
U.S.A.

(4) TPS TECHNI TUBE ROHRENWERKE GMBH
POST BOX 1360
INDUSTRIEGEBIET
D-5568 DAUN,
(F.R. GERMANY)

TPS. TECHNITABE (U.K.) LTD.,
BLATCHFORD ROAD WORKS
HORSHAM/WEST SUSSEX

TELEX: 87481

(5) M/S. MANNESMANN HANDEL
DEPARTMENT AR3(PROJECT
CO-ORDINATION)
POST FACH 5502
NIEDERKASSELER LOHWEG 20
D-4000 DUSSELDORF 11(SEESTEM)
WEST GERMANY

ANNEXURE - VIII

(A) NAME AND ADDRESS OF PARTIES-FABRICATORS OF TANTALUM LINED EQUIPMENTS:

(1) M/S. TITANIUM TANTALUM PRODUCTS
PRIVATE LIMITED
86/1, VENGAIVASAL MAIN ROAD,
GORVIVAKKAM,
MADRAS-601 302

TELEX: 041-6659 INDIA

(2) M/S. TITANIUM EQUIPMENT & ANODE
MANUFACTURING COMPANY LIMITED
TEAM HOUSE,
G.S.T. SALAI,
VANDALUR,
MADRAS-600 048.

(3) M/S. ALFA-LAVAL(INDIA) LIMITED
(FORMELY VULCUN LAVAL LTD.)
DAPODI,
PUNE-411 012

TELEX: 0146-219/259
MUSTAFA BUILDING,
7A, SIR P.M. ROAD,
BOMBAY-400 001.

ANNEXURE - IX

GLASS LINED EQUIPMENT MANUFACTURERS :

(1) M/S. VE AUSSENHANDELSBE JRICB TECHNOCOMMERCE
JOHANNES - DIECKMANN - STR
11/13, BERLIN 1080 GDR.

TLX NO: 114163 AHTC DD

(2) M/S. GUJARAT MACHINERY MANUFACTURERS LTD.,
P.B. NO.1, KARAMSAD-388 325
GUJARAT,INDIA

TELEX NO : 0172-204

(3) M/S. VEB EISEN IND HUETTENWERKE THANE
ABT. BEHAELTR - UND APPARATEBAU DDR - 4308 THALE
GDR.

TLX NO : 48521 - 4344 EHW DD

ADDRESSES OF PARTIES SUPPLYING ULTRASONIC THICKNESS METERS & ULTRASONIC FLAW DETECTORS.

ANNEXURE - X

1. M/S. PANAMETRICS
221, ERE CRESCENT STREET,
WALTHAM,
MASSACTUSETTS 02254/899-2719.

TELEX: 6817337/FAX 6178991552.

2. M/S. KRAUT KRAMER GMBH
ROBERT BOSCH STR.,
3 D 5030 HURTH 5, W.GERMANY.

TELEX: 8881643

3. M/S. STRESSTEL
225 TECHNOLOGY CIRCLE,
SCOTTS, VALLEY,
CA 95066 USA

TLX.: 330014

4. M/S. BAUGH & WEEDON LIMITED,
WIDEMARSH STREET,
HEREFORD, HR4 9EZ
ENGLAND.

TLX.: 35398

5. M/S. SONATEST, DICKENS, ROAD, OLD WOLVERTON,
MILTON KEYNES MK 125 QQ, ENGLAND,

TLX.NO.: 826131 SONAMK G.

A DIVISION OF SCHUMBERGER ELECTRONIC (UK) LTD.

6. M/S. KAWATETSU INSTRUMENTS CO. LTD.,
3-48; TAKAHATA CHO, NISHINORMIYA,
HYOGO PREF. JAPAN.

TLX. : 0798 - 66 - 1501.

7. M/S. THE MODERN MERCANTILE WORKS
MEHERHOUSE, 15, CAWASJI PATEL STREET,
FORT, BOMBAY-400 023.

TLX.: 011-5642 MMIN - IN.

8. M/S. VIBRONICS PVT. LTD.,
P.O. BOX NO. 7182, KURLA,
BOMBAY - 400 070.
TLX NO.: 011-71022 VIBR IN

9. M/S. ELECTRONIC & ENGINEERING COMPANY
P.BOX NO. 17356, VEERA DESAI ROAD,
ANDHERI(WEST), BOMBAY-400 058.

TLX : 011 78099 EEC IN

(..2..)

10. M/S. KARL DEUSTCH
GMBH AND COMPANY KG
PRUF - UND MESSGERATEBAN
D-5600 WUPPERTAL 1
OTTO - HAUSMANN RING 101
P.O. BOX : 132354

TLX NO : 8591 130 K DEU D

INDIAN CONTACT:

M/S. EMPIRE MACHINE TOOLS,
EMPIRE HOUSE 414, SENAPATI BAPAT MARG,
LOWER PAREL, BOMBAY 400 013.

TLX.: 011-73888

11. M/S. HITACHI CONSTRUCTION MACHINERY CO.LTD.
NIPPON BUILDING NO.62
2 - CHROME OHTEMACHI
CHIYODA - KU TOKYO - 100 JAPAN

TLX : J32539 HITACONJ.

INDIAN CONTACT :

M/S. MEMCORD MARKETING PVT.LTD.
304, HILL VIEW INDUSTRIAL ESTATE,
BEHIND GHATKOPER INDUSTRIAL ESTATE,
OFF. L.B.S. MARG, GHATKOPER(W)
BOMBAY-400 086.

PHONE : 588552 & 3

ANNEXURE - XI

ADDRESSES OF PARTIES SUPPLYING "DYE PENETRANT TEST" KIT.

1. M/S. P. MET COMPANY
1/5-6 INDUSTRIAL ESTATE,
GORWA ROAD,
VADODARA - 390 016.
PHONE - 320 626

2. M/S. CHECKMATE CHEMICALS PVT.LTD.,
2401, TILAK STREET, PAHARGANJ,
NEW DELHI - 110 055.
TLX. 31-65047 DUBE - IN

AT BARODA :

M/S. BRODWELD ASSOCIATES PUSHKAR
PROF. MANEKRAO ROAD, DANDIA BAZAR, CROSSING,
BARODA-390 001.

3. M/S. PRADEEP METAL TREATMENT CHEMICALS P.LTD.
PLOT NO. A 488/489, ROAD U,
WAGLE INDUSTRIAL ESTATE,
THANE - 400 604.

4. M/S. ZYGLO,
MAGNAFLUX CORPORATION,
CHICAGO ILLINOIS 60656.

ANNEXURE - XII

TUNGSTEN INERT GAS WELDING PROCESS :

INTRODUCTION:

In the Tungsten inert gas process that heat necessary to melt the metal is provided by a very intense electric arc which is struck between a virtually non consumable tungesten electrode and the metal work piece. The electrode does not melts and become a part of the weld. On joints where filler metal is required, a welding rod is fed into the weld zone and melted with the base metal in the same manner as that used with oxy acetylene welding. The weld pool is protected by shielding it with an inert gas such as Helium or Argon. The gas is fed through the weld torch.

Tungsten and Thoriated Tungsten electrodes are practically non-consumable. They have very high melting temperature since pure Tungsten melts at 6098 F.

ADVANTAGES -:

(i) The weld zone is shielded from the atmosphere by an inertgas which is fed through the welding torch. Due to this protection from atmospheric gases, the weld metal by this process is strong or, more ductile, more corrosion resistant and less porous than welds made with the ordinary metal arc welding process.

ii) The characteristics of the arc are such that the welding heat is confined to a small area. This results in

a) A narrow heat affected zone.
b) Reduced distortion
c) Faster welding speeds
d) Entire welding action takes place without spattering, sparks, or fumes.

iii) No need of flux. Hence

a) No flux removal with consequent saving in time and expense.
b) Greater visibility of the weld pool, which affords closer control and improved welding quality.
c) No corrosion due to entrapped flux, resulting in smoother, nonporous welds.

iv) Simple filler metal control provides :

a) Economy, since the filler metal is Independent of the arc and need to be added only when necessary.

b) Improved appearance of joints, as the weld pool can be seen clearly.

(..2..)

c) Use of filler metal frequently can be eliminated in the welding of medium to thin stock where good fitup can be secured.

The tungsten inert gas process is adoptable to most commercially used metals such as Aluminium Magnesium, their alloys, stainless steels lead, brass, monel Copper, Inconel, Molybdenum, Nickel alloys and phosphorous bronze.

USE OF TIG IN CHEMICAL/PETROCHEMICAL PLANT :

* TIG welding is generally used in such plants to weld thin sheets/ pipes of St. steel(up to - 4mm thk.), exotic metals like Ti, Ta, Zr, Ni, Monel, Inconels, Hastelloys, Aluminium etc.

* It is invariably used for welding tubes to tubesheet joints (seal, strength welding) in heat exchangers.

* Since in case of pipe welding no back chipping is possible argon purging is a must to protect the other side of the weldment from oxidation.

* For both purging/shielding Nitrogen gas is never recommended as it forms metal nitrides.