OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

22922

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

TECHNICAL REPORT ON CONVERSION OF CARBON TETRA CHLORIDE TO MONOCHLORO BENZENE AS PROCESS AGENT IN LABORATORY

Three trial batches in the Laboratory for conversion of Orthonitro Toluene to N-Methyl Cyclohexyl Ortho Nitro Toluene Hydrochloride were undertaken from 20th Dec., 2002 to 28th Dec., 2002 under the supervision of Dr. D. R. Nadkarni.

Laboratory trials were done using Orthonitro Toluene as starting material. The batches were of 200 gms.

The trials were taken in Laboratory and the following raw materials were used for each trial :

1.	Orthonitro Toluene	-	200 gms.
2.	Dibromo Dimethyl Hydentoin	-	200 gms.
3.	A. I. B. N.	-	6 gms.
4.	Monochloro Benzene	-	1600 ml.
5.	N.Methyl Cyclohexylamine	-	144 gms.
6.	Soda bicarbonate	-	110 gms.
7.	Hydrochloric Acid	-	160 ml.
8.	Water	-	420 ml.

Total time for each trial batch was 40 hrs. The three Laboratory trial batches were started on 20th Dec., 2002 and finised on 28th Dec., 2002.

The following output were obtained :

Lab. Batch No.	Quantity	Melting Point	Colour	Assay
01	230 gms.	225°C	Creamish	99.2%
02	239 gms.	225.2°C	Creamish	99.2%
03	240 gms.	225.2°C	Creamish	99.3%

The temperature of the reaction was kept at 80°C as is done using Carbon Tetrachloride and the time of reaction in 1st stage i. e. of converting Orthonitro Toluene to Orthonitro Benzyl Bromide was kept as in 1st trial Batch 12 hrs. in 2nd trial batch 14 hrs. The time was increased as we got less output in the 1st trial. In the 3rd trial batch time again taken 14 hrs. got the required result.

(cont'd .... 2)

Separation of Water and Monochloro Benzene

More time was needed for the layers to separate compared to water and Carbon Tetra Chloride Layers.

Distillation

Distillation of monochloro benzene was done at 80°C under vacuum but the temperature was not raised to its boiling point as traces of unreacted Ortho Nitro Toluene and Ortho Nitro Benzyl Bromide may be there and could cause explosion.

All three Laboratory trials were continuously monitored by Dr. D. R. Nadkarni. Analysis Report of the 3 Laboratory trial batches are enclosed herewith.

Laboratory trial were conducted and report prepared under the supervision of Dr. D. R. Nadkarni.

DR. D. R. NADKARNI
(CONSULTANT)

ASHOK TIKOTKAR
(PRODUCTION MANAGER)

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

CERTIFICATE OF ANALYSIS

Certificate No.	: GRD/Lab Trial/01	Date	: 22.12.2002
Name of the Manufacturer	: SELF	Date of Manufacturing	: Dec., 2002
Name of Sample	: N-Methyl Cyclohexyl Orthonitro Toluene Hcl	Date of Expiry	:
Batch Number	: LAB TRIAL-1	Date of receipt of the Sample	: 22.12.202
Qty. of ONT	: 200 gms.	Date of Analysis	: 22.12.2002

RESULT OF TEST ANALYSIS

Colour	: Creamish
Melting Point	: 225°C
Assay	: 99.2%
TLC	: Complies.

In the opinion of the undersigned the sample referred to above is of Standard Quality.

ANALYST

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

CERTIFICATE OF ANALYSIS

Certificate No.	: GRD/Lab Trial/02	Date	: 25.12.2002
Name of the Manufacturer	: SELF	Date of Manufacturing	: Dec., 2002
Name of Sample	: N-Methyl Cyclohexyl Orthonitro Toluene Hcl	Date of Expiry	:
Batch Number	: LAB TRIAL-2	Date of receipt of the Sample	: 25.12.2002
Qty. of ONT	: 200 gms.	Date of Analysis	: 25.12.2002

RESULT OF TEST ANALYSIS

Colour	: Creamish
Melting Point	: 225.2°C
Assay	: 99.2%
TLC	: Complies.

In the opinion of the undersigned the sample referred to above is of Standard Quality.

ANALYST

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

CERTIFICATE OF ANALYSIS

Certificate No.	: GRD/Lab Trial/03	Date	: 28.12.2002
Name of the Manufacturer	: SELF	Date of Manufacturing	: Dec., 2002
Name of Sample	: N-Methyl Cyclohexyl Orthonitro Toluene Hcl	Date of Expiry	:
Batch Number	: LAB TRIAL-3	Date of receipt of the Sample	: 28.12.2002
Qty. of ONT	: 200 gms.	Date of Analysis	: 28.12.2002

RESULT OF TEST ANALYSIS

Colour	: Creamish
Melting Point	: 225.2°C
Assay	: 99.3%
TLC	: Complies.

In the opinion of the undersigned the sample referred to above is of Standard Quality.

ANALYST

GRD CHEMICALS PVT. LTD., INDORE (M. P. - INDIA)

TECHNICAL REPORT ON CONVERSION OF CARBON TETRACHLORIDE TO MONOCHLORO BENZENE AS PROCESS AGENT IN PLANT

Three trial batches in the Plant for Conversion of Ortho Nitro Toluene to N-methyl Cyclohexyl Ortho Nitro Toluene Hydrochloride were undertaken from 15th Jan., 2003 to 2nd February, 2003 under the supervision of Dr. D. R. Nadkarni. Each batch was done using 70 kgs of Orthonitro Toluene as starting material.

The three trial batches were done in the Plant using the existing Plant and machinery.

The following raw material were used for each batch :

1.	Orthonitro Toluene	-	70 kgs.
2.	Dibromo Dimethyl Hydention	-	70 kgs.
3.	A. I. B. N.	-	2.1 kgs.
4.	Monochloro Benzene	-	560 kgs.
5.	N-methyl Cyclohexylamine	-	50.4 kgs.
6.	Sodabicarbonate	-	38.5 kgs.
7.	Water	-	147 ltrs.
8.	Hydrochloric Acid	-	56 ltrs.

The first trial batch was started on 15th January, 2003 and finished on 20th January, 2003 The second batch started on 21st January, 2003 and finished on 26th January, 2003 and the third batch was started on 27th January, 2003 and finished on 2nd Feb., 2003.

The reaction was done in glasslined reactor and the distillation in S. S. Reactor.

(cont' d .... 2)

Following outputs were obtained in the three batches :

Batch Nos.	Starting Batch Qty. of	Qty. obtained
01	70 kgs.	83.5 kgs.
02	70 kgs.	84.2 "
03	70 kgs.	84.0 "

Reactions

I) Conversion of Orthonitro Toluene to Orthonitro Benzyl Bromide (Bromination)

MATERIAL TAKEN :

Orthonitro toluene	-	70 kgs.
Dibromo Dimethyl Hydentoin	-	70 kgs.
AIBN	-	2. 1 kgs.
Monochloro Benzene	-	560 kgs.

All the above material were taken in G. L. Reactor at room temp.

The reaction w as carried out at 80°C below the boiling point of MCB. Hence reflux was not possible. Tempreture was maintained throughout the reaction time. Time taken for reaction 14 hrs. After the reaction was completed a sample was taken out for TLC. TLC was performed for the completion of reaction.

I I) Conversinon Orthonitro Benzyl Bromide to N-Methyl Cyclohexyl Orthonitro Toluene - (Condensation)

MATERIAL TAKEN :

Soda-bi-Carbonate	-	38.5 kgs
Water	-	147 ltrs.
N.Methyl Cyclohexylamine	-	50.4 kgs.

SodabiCarbonate and Water were mixed in separate Container and added to G. L. Reactor at the temp. 50°C raised temp. to 60°C and maintained for 1 hr. N-Methyl Cyclohexalamine was added slowly at temp. 60°C.

The reaction was carried out at 70°C and maintained for 2 hrs. below the boiling point of MCB. Temperature was maintained throughout the reaction. Sample was taken out for TLC and performed TLC for completion of reaction.

(cont'd .... 3)

III) Layer Separation

Time taken for layer to separate was much more than in the case of water - CTC layer separation. But the separation was good and the layers were separated. The layers were washed and the water layer discarded.

IV) Converting N Methyl Cyclohexyl Orthonitro Toluene to its Hydrochloride Salt

Material - Hydrochloric Acid - 56 ltrs.

To MCB layer HCL acid was added at 40°C slowly to convert it to Hydrochloride Salt. The Plant was cooled to 5°C for complete precipitation.

V) Filteration and drying

The hydrochloride salt was filtered through centrifuge and dried.

VI) Distillation of Solvent MCB

During the distillation of monochloro benzene, the heating was kept at 80°C as in the case of Carbontetrachloride, due to higher boiling point of MCB it was distilled under Vacuum to get proper distillation rate.

The trap provided in the vacuum line was kept at lower temperature to minimise the MCB vapours to go to Vacuum Pump.

Distillation was not done at MCB boiling point (to eliminate the risk of explosion) as traces of unreacted Orthonitro Toluene and Orthonitro benzylbromide may be present in MCB.

During the charging of MCB and at all stages proper safety precaution i.e. earthing, personal protection equipments were used.

Dr. D. R. Nadkarni continuously monitored the processing of the 3 batches and gave valuable advice to Supervisors and Workers regarding operation procedures.

(cont'd.... 4)

The yields and quality of all the three batches were as per the standards and were same as we get using Carbon Tetrachloride.

The sample were taken out after Bromination stage and condensation stage to know the completion of reaction.

The final product N-Methyl Cyclohexyl Orthonitro Toluene Hydrochloride was also analysed for percentage purity and melting point.

The analytical reports for the above three batches are enclosed with this report.

The report in tabular form

S. No.	Stages at which samples were taken out	Test Carried	Batch No.1	Batch No.2	Batch No.3
1.	Completion of 1st stage (Bromination)	TLC	complies	complies	complies
2.	Completion of 2nd stage (condensation)	TLC	complies	complies	complies
3.	Conversion to Hydrochloride Salt	Melting Point	225°C	225.4°C	225.2°C
		ASSAY	99%	99.4%	99.2%

With completion of three trial batches the Company has successfully conducted material compatibility and realiability tests for conversion of Carbon Tetra Chloride to Monochloro Benzene as process agent in the manufacturing of Bromhexine Hydrochloride.

Trial batches conducted and report prepared under the supervision of Dr. D. R. Nadkarni.

DR. D. R. NADKARNI
(CONSULTANT)

ASHOK TIKOTKAR
(PRODUCTION MANAGER)

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

CERTIFICATE OF ANALYSIS

Certificate No.	: GRD/Plant Trial/01	Date	: 21.01.2003
Name of the Manufacturer	: SELF	Date of Manufacturing	: Jan., 2003
Name of Sample	: N-Methyl Cyclohexyl Orthonitro Toluene Hcl	Date of Expiry	:
Batch Number	: PLANT TRIAL- 1	Date of receipt of the Sample	: 21.01.2003
Qty. of ONT	: 70 kgs.	Date of Analysis	: 21.01.2003

RESULT OF TEST ANALYSIS

Colour	: Creamish
Melting Point	: 225°C
Assay	: 99%
TLC	: Complies.

In the opinion of the undersigned the sample referred to above is of Standard Quality.

ANALYST

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

CERTIFICATE OF ANALYSIS

Certificate No.	: GRD/Plant Trial/02	Date	: 27.01.2003
Name of the Manufacturer	: SELF	Date of Manufacturing	: Jan., 2003
Name of Sample	: N-Methyl Cyclohexyl Orthonitro Toluene Hcl	Date of Expiry	:
Batch Number	: PLANT TRIAL- 2	Date of receipt of the Sample	: 27.01.2003
Qty. of ONT	: 70 kgs.	Date of Analysis	: 27.01.2003

RESULT OF TEST ANALYSIS

Colour	: Creamish
Melting Point	: 225.4°C
Assay	: 99.4%
TLC	: Complies.

In the opinion of the undersigned the sample referred to above is of Standard Quality.

ANALYST

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

CERTIFICATE OF ANALYSIS

Certificate No.	: GRD/Plant Trial/03	Date	: 03.02.2003
Name of the Manufacturer	: SELF	Date of Manufacturing	: Feb., 2003
Name of Sample	: N-Methyl Cyclohexyl Orthonitro Toluene Hcl	Date of Expiry	:
Batch Number	: PLANT TRIAL- 3	Date of receipt of the Sample	: 03.02.2003
Qty. of ONT	: 70 kgs.	Date of Analysis	: 03.02.2003

RESULT OF TEST ANALYSIS

Colour	: Creamish
Melting Point	: 225.2°C
Assay	: 99.2%
TLC	: Complies.

In the opinion of the undersigned the sample referred to above is of Standard Quality.

ANALYST

GRD CHEMICALS PVT. LTD., INDORE (M P - INDIA)

TRAINING REPORT

Conversion of Carbon Tetra Chloride to Mono Chloro Benzene as process agent in manufacturing N-Methyl Cyclohexyl Ortho Nitro Toluene Hydrochloride from Othro Nitro Toluene in the manufacturing process of Bromhexine Hydrochloride.

Training conducted by Dr. D. R. Nadkarni.

The Company appointed Dr. D. R. Nadkarni who is professionally qualified and familiar with the use of Monochloro Benzene as process agent and with the manufacturing of Bromhexine Hydrochloride using Monochloro Benzene.

For training on use of MCB to Production Manager, Supervisors and Workers a training programme was organised which was conducted by Dr. D. R. Nadkarni in factory premises from 4th Jan., 2003 to 7th Jan., 2003

The training focussed primarily on the following points :

- Safety requirements in handling MCB.
- Fire and Explosive hazards of MCB.
- Handling Emergencies

SAFETY REQUIREMENT IN HANDLING MCB :

COMPARITIVE STUDY DATA OF CTC AND MCB.

Properties	C T C	M C B
Appearance	Clear Liquid	Clear Liquid
Odour	Sweet Odour	Faint not unpleasent odour Almond like odour
Boiling Point	76.7°C	132°C
Density	1.58	1.105
M. P.	-	45°C
Flash Point	-	+ 29.5°C
Toxicity	Poison	-
Flammability	Non-Flammable	Flammable
Solubility in Water	Insoluble	Insoluble
Molecular Weight	153.84	112.56
Exposure Limit		75 ppm

(Cont'd... 2)

As MCB comes under flammable category and exposure limit for human being is 75 ppm, all care must be taken for it. Proper clothing is must when you use MCB. To ensure that all your Plants are properly earthed.

As MCB is more flammable than CTC, Dr. Nadkarni suggested safety precaution to be taken while handling MCB. Dr. Nadkarni then detailed about the health risks of using MCB and how to protect.

SENSITIVITY DATA

If MCB is spilled on clothing and allowed to remain there may cause smarting and redness of skin. Irritation to eyes and nose. He suggested to change the clothing and have a wash before restarting the work.

PROTECTION TO BE USED

Eyes - wear face shield with safety glasses.
Skin - wear gloves, boots, apron and respirator to be used while handling.

STORAGE

Always store MCB in cool, dry, well ventilated place, store away from the source of ignition. Do not store at temp. above 37°C. Keep containers tightly closed.

SHELL LIFE

MCB is stable for 1 year under proper storage conditions. Plastic containers for packaging is not generally recommended due to vapour transmission.

HANDLING

Avoid contact with skin, eyes and clothing.

VENTILLATION

Proper ventillation must be there.

ORGAN TOXICITY DATA

Irritation to eyes, skin, mucous membrane, inhalation may produce CNS depression and narcotic effects at high exposure concentration.

(cont'd ... 3)

CARCINOGENECITY

Not known or reported to be carcinogenicity.

HEALTH EFFECTS

INHALATION

Acute - irritation to throat, nose, lungs, narcotic and CNS depression with symptoms of headache, breathing difficulty, dizziness, drowsiness, weakness, nausea, vomiting, loss of coordination.

Chronic - Lung, Kidney, Liver damage.

SKIN

Acute - irritation, redness of skin
Chronic - defalting of skin leading to dermatitis.

EYES

Direct contact to cuase irritation, redness, swelling, tearing, itching. No impairment of vision would be expected to occur.

INGESTION

Acute - Irritation of throat and mouth. G. I. discomfort with any or all of the following symptoms :
Nausea, vomitting, lethargy, irritation, diarrhoea.

Chronic - Expected to cause more severe CNS effects if repeatedly ingested it may produce Liver, Kidney damage.

FIRST AID

Inhalation

If experience nausea, headache, dizziness move to fresh air area if breathing difficult administer Oxygen.

Ingestion

Immediately give large quantity of water and induce vomiting.

(cont' d ... 4)

Skin

Flush with water for 15 minutes. Wash the skin with soap and water.

Eyes

Immediately flush eyes with large quantities of water occassionally lifting upper and lower eyelids.

FIRE HAZARD

Extinguishing Media

Carbondioxide, regular foam, dry chemical, water spray.

Special Procedure

Use water to cool container exposed to fire. Wear proper protective requirements.

Incompatibles

Oxidising agents, Acids, Bases, reducing agents, open flame, heat, sparks

Requirement of MCB per batch would increase compared to CTC that means quantity of solvent handled would be increase almost 1.5 times.

Specific gravity of MCB is 1.1 whereas of CTC is 1.58 and so while using MCB more time to be given for settling and layer separation of organic and aquous layer. As such the time given of settling to be increased.

Safety precautions to be taken while handling MCB.

1. MCB vapours may be irritating to skin, eyes, nose & throat. Inahalation of vapours may cause nausea, vomiting, head ache or loss of consciousness. Chronic :- may cause kidney & liver damage. So while charging MCB from Drums \ Tanks to Reactor, use personal protective clothing and gas masks to avoid inhalation of MCB vapours.

2. The storage tank of MCB must be equipped with a vent which should be taken outside of the plant so that the generated vapours could escape.

3. All electrical appliances such as motors, bulbs, starters must be fitted with flameproof assembly in order to avoid any chances of sparks in the plant.

(cont'd .... 5)

4. Self-contained air breathing apparatus must be available in the Plant and used whenever exposed to MCB vapours or fire.

5. During charging & unloading of MCB from Reactor earthing and bonding must be used as MCB can catch fire due to static electricity.

6. The boiling point of MCB is more than CTC so during distillation more heating is required but because of nature of other chemicals present in MCB distillation to be done at low temp. of 80°C under vacuum and in no case the temp. should be more than 100°C. As distillation is being done under Vacuum, care must be taken for vapours of MCB going to Vacuum Pump.

7. MCB Drums must be stored in a well ventillated room.

HANDLING DURING EMERGENCY

Following steps have been suggested by Dr. Nadkarni to be taken during emergency :

1. During the spillage of MCB on floor wash the floor with plenty of water to it.

2. While splashing of MCB on skin or in eyes wash them immediately with water and take the advice of the Doctor.

3. In case of vapour loss from condenser use air mask and protective clothing before exposing to vapours.

4. Do not operate any electrical switches if non-flame proof during vapour loss of MCB in plant.

5. In case of MCB fire use dry chemicals powder or foam type fire extinguishers.

6. In case of leakage of MCB, rectify and stop the leakage from a distant point if possible.

(cont'd ... 6)

Emmission of Gases generated during production and use of Air Scrubber

Dr. Nadkarni explained that during bromination i.e. when Orthonitro Toluene is converted to Orthonitro Benzyl Bromide / Hydrobromic Acid fumes are generated. Because of the generation of these fumes we have to take some precautions.

- To take out the fumes from the reactor in such a way that they do not pass in atmosphere.

- To neutralize / scrubb these fumes so they become inactive.

To do this an air scrubber will be used which is fitted with arrangement to have a shower of caustic solution and is also fitted with a blower.

The blower will help the fumes to come out of reactor and enter the scrubber where the fumes will come in contact with shower of caustic solution and will be neutralised.

The hydrobromic acid fumes are pungent, causes irritation to nose, throat, eyes hence proper protection must be used.

To check the concentration of Caustic Solution as it will change after some time as it reacts with fumes.

Precaution must be taken that pumping of caustic solution with the help of pump is always maintained during the course of reaction.

Treatment of generated effluents

There will not be any change in effluent by changing carbon tetra chloride to monochloro benzene as process agent.

The major effluent will be generated after water layer separation and washing of organic layer with water.

The water layers will be taken to settling tank and the overflow of which is taken for ph adjustment. The ph is maintained around 7.0

The overflow of precipitation tank is taken in next tank from where it it sent to central affluent treatment plant.

Cont. - 7

During the training session Dr. Nadkarni also discussed the use of other chemicals and action to be taken during emergency.

During the whole training session many questions were asked by staff and workers which were thoroughly explained by Dr. Nadkarni in a satisfactory way and at the end of the training programme the staff and workers were thoroughly satisfied with Dr. Nadkarni. Whole training session not only gave an overall view of using MCB but also included knowledge, handling, safety precaution of other chemicals being used in the Plant.

DR. D. R. NADKARNI
(CONSULTANT)

ASHOK TIKOTKAR
(PRODUCTION MANAGER)