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INTRODUCTION

Calcium carbide, CaC_2 when pure, is transparent and colourless, with a specific gravity of 2.22 at 180°C . It may be prepared in the laboratory by the thermal decomposition under vacuum of pure calcium cyanamide in the presence of carbon to produce absolutely white calcium carbide. Pure CaC_2 is variety, and the general properties of calcium carbide have been determined by extrapolation from values obtained on high - purity commercial carbide.

Commercial calcium carbide varies in colour from Steel-grey to reddish brown, depending on impurities and the method of manufacture. It is made from lime and coke in the electric furnace at temperature of $2200 - 2500^\circ\text{C}$, using large amount of electric power.

Industrial calcium carbide is about 80% pure remaining is calcium oxide and 2-5% other impurities. Its outstanding property is that of reacting with water to produce acetylene gas.

Commercial calcium carbide is the main source of acetylene, and acetylene is used principally in the synthesis of a series of organic chemicals, resins, and plastics and in oxyacetylene welding and cutting of metals. Large amounts of carbide are also made for the production of calcium cyanamide by the fixation of atmospheric nitrogen. The cyanamide is, in turn, used as a fertilizer and as the basis for a series of chemicals and resins. Smaller amounts of calcium carbide are used as a dehydrating agent and as a reducing and desulfurizing agent in metallurgical processes.

Calcium carbide was made in the laboratory by early workers such as Hare and Wohler. It also was formed as a side reaction product in various industrial processes, but it was not isolated or recognized.



PROPERTIES OF CALCIUM CARBIDE

Crystallography

Commercial calcium carbide occurs in four different crystalline modifications- cube, tetragonal, and two of a lower order of symmetry. The cubic form designated CaC_2 'IV' is stable at 447°C , the tetragonal form, CaC_2 'I' is stable between 447°C and 25°C , and the form CaC_2 'II' below 25°C , the form CaC_2 'III' is known only as a metastable phase. The tetragonal form CaC_2 'I' is the one most common in commercial carbide.

Melting Point

The most extensive data on technical carbide are those of all who use more than eighty sample in which the calcium carbide content ranges from 4 to 94%. By extrapolation of the two ends of the curve, the melting points of calcium carbide and calcium oxide were indicated to be about 2300 to 2500°C .

Composition

Microscopic examinations of different samples of the system by all showed clearly the two components CaC_2 and CaO in the form of black crystals in a lighter background of the two autectics. Thus physical chemical and optical methods of examination have indicated the presence of the compound CaC_2 , CaO . This compound is unsuitable and easily decomposed at temperature approaching the melting point of the compound. Its heat of formation from CaO and CaC_2 as determined from its heat of solution in dilute hydrochloric acid in 37.4 Kcal gm-mole (exothermic).

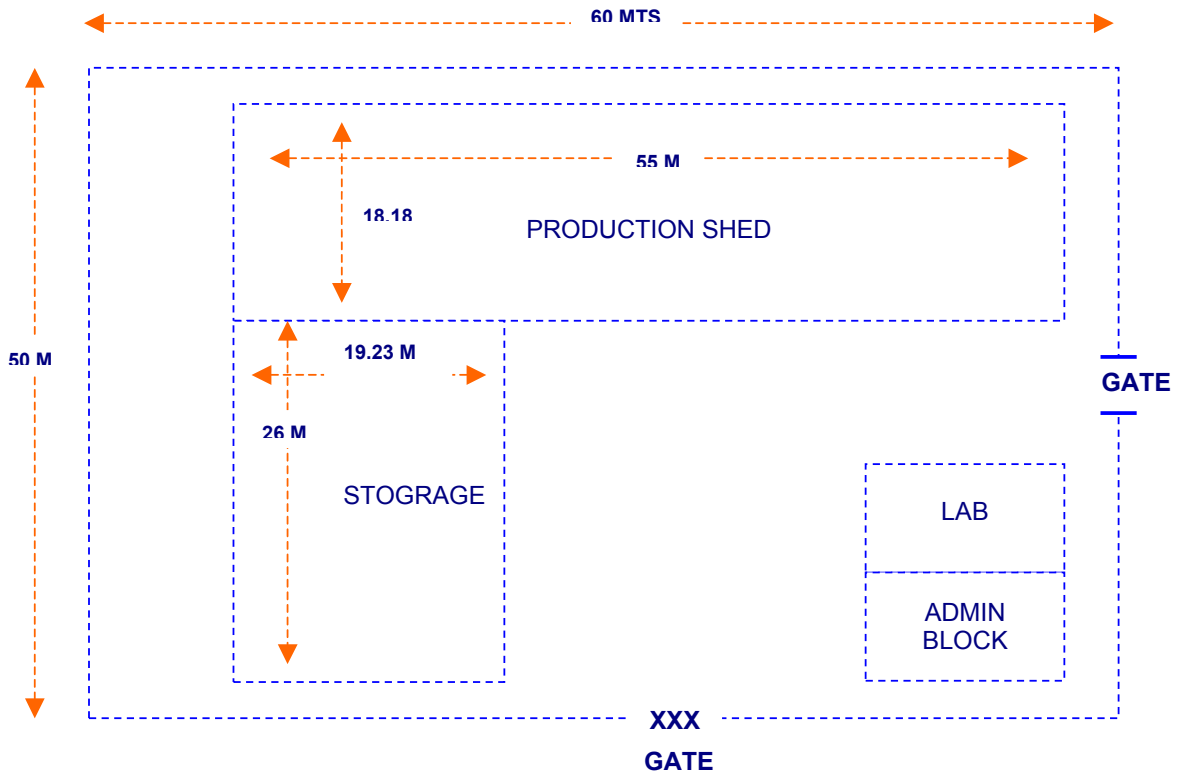
Specific Gravity

Determination of the specific gravity diagram by the pycnometer method, on this series of compounds by all confirm the existence of the compound CaC_2 , CaO at about 52% calcium carbide with a specific gravity of 2.54. By extrapolation of the specific volume curve, the sp. gravity of CaC_2 was indicated to be 2.155 within an accuracy of 0.8%. The sp. gravity of commercial calcium carbide thus depends upon its CaC_2 content, and for the 80% commercial carbide the specific gravity of the solid at 15°C is 2.28-2.32, and for the liquid at 2000°C , it is 1.85.

Electrical Conductivity

The electrical conductivity of the system CaO-CaC_2 was determined by Asll at 20°C , and the resulting curve indicates a falling conductivity from calcium carbide. to that of lime, the two minim with abscissas at 75 and 38% CaC_2 correspond to the two eutectics formed by CaC_2 CaO with CaC_2 and with CaO whereas the maximum occurs at about the composition of the compound CaC_2CaO . The electrical conductivity of this compound is indicated to be about 0.30-Cm^{-1} . As also showed that the conductivity of carbide increases with the temperature and that this increase is linear.

PLANT LAYOUT



PLANT LOCATION FACTORS

Factors which generally apply to the economic and operability aspect of plant site location are classified into two major groups. The primary factors listed apply to choice of a region, whereas the specific factors looked at in choosing an exact site location within the region. All factors are important in making a site location selection.

Primary Factors

1. Raw-material supply:

a.	Availability form existing or future suppliers
b.	Use of substitute materials
c.	Distance

2. Markets:

a.	Demand versus distance
b.	Growth or decline
c.	Inventory storage requirements
d.	Competition - present and future.

3. Power and fuel supply:

a.	Availability of electricity and various type of fuel
b.	Future reservers
c.	Costs

4. Water supply:

a.	Quality - temperature, mineral content, bacteriological content
b.	Quantity
c.	Dependability - may involve reservoir construction
d.	Costs

5. Climate:

a.	Investment required for construction
b.	Humidity and temperature conditions
c.	Hurricane, a tornado, and earthquake history

Specific Factors

6. Transportation:

a. Availability of various services and projected rates

1.	Rail - dependable for light and heavy shipping over all distances
2.	Highways - regularly used for short distance and generally small quantities
3.	Water - cheaper, but may be slow and irregular
4.	Pipeline - for gases and liquids, particularly for petroleum products
5.	Air - for business transportation of personnel

7. Waste disposal:

a.	Regulations laws
b.	Stream carry-off possibilities
c.	Air-pollution possibilities

8. Labor:

1.	Availability of skills
2.	Labor relations - history and stability in area
3.	Stability of labor rates

9. Regulatory laws:

a.	Building codes
b.	Zoning ordinances
c.	Highway restrictions
d.	Waste-disposal codes

10. Taxes:

a. State and local taxes

1.	Income
2.	Unemployment insurance
3.	Franchise
4.	Use
5.	Property

b. Low assessment or limited term exemptions to attract industry

11. Site characteristics:

a.	Contour of site
b.	Soil structure
c.	Access to rail, highway, and water
d.	Room for expansion
e.	Cost of site
f.	Site and facilities available by expansion on present company-owned property

12. Community factors:

a.	Rural or Urban
b.	Housing costs
c.	Cultural aspects - churches, libraries, theaters
d.	School system
e.	Recreation facilities
f.	Medical facilities - hospitals, doctors

13. Vulnerability to wartime attack:

a.	Distance form important facilities
b.	General industry concentration

14. Flood and fire control:

a.	Fire hazards in surrounding area
b.	Flood history and control

SUPPLIERS OF LIMESTONE

PLANT ECONOMICS

Rated Plant capacity = 4.00 MT/day
= 1200.00 MT/annum
CALCIUM CARBIDE

Basis

No. of working days = 25 days/month
= 300 days/annum

No. of shifts = 1 per day

One shift = 8 hours

Currency - Rs.

LAND & BUILDING

1.	Land Area Required 4000 sq.mts. @ Rs.500/- per sq.mtr.	Rs.	20,00,000.00
2.	Covered Area: production shed 1500 sq.mts. @ Rs.3000/-per sq.mtr.	Rs.	45,00,000.00
3.	Storage of raw material and finished product 500 sq.mts. @ Rs.2000/-per sq.mtr.	Rs.	10,00,000.00
4.	Office & Laboratories 150 sq.mts. @ Rs.4000/-per sq.mtr.	Rs.	6,00,000.00
5.	Storage Silos	Rs.	2,00,000.00
6.	Site development, Roads, Sewage Boundary wall, gate, etc.	Rs.	5,50,000.00
	TOTAL	Rs.	88,50,000.00

PLANT & MACHINERY

1. A) LIME SECTION:			
1. Vertical Shaft kiln, equipped with vertical hoist, motor half-		Rs.	0.01
2. Covered roof (platform) trolley and rolls for the movement of trolley, lined with high temperature-		Rs.	0.01
3. Refractory bricks in the calcining zone, provided with four outlet at the bottom reinforced with steel-		Rs.	0.01
4. Strips cap. 1.00 Mt per hour	1 No.	Rs.	0.01
5. 2. Vibrating Screen			
b) Section of Carbide			
1. Three-phase electric Arc furnace		Rs.	0.01
6. Continuous type equipped 3 Nos. provided with vertical hoist motor, platform provided at the top of the		Rs.	0.01
7. Furnace, hopper to feed the raw materials lined with high temp. refractory bricks & pitch cap. -		Rs.	0.01
8. = 0.5 MT per hour output.	1 No.	Rs.	0.01
9. Jaw crusher cap. 0.5 MT/hr in put size 4-8 inch out put size 2"1	1 No.	Rs.	0.01
10. Rolling mill slow movement, cap. 0.5 MT/hr output 20-30 mesh.	1 No.	Rs.	0.01
11. Pebble mill input size less than 2" output size 85 % to pass through 300 mesh cap. 0.5 MT per hr.	1 No.	Rs.	0.01
12. Vibrating screen with a set of sieves cap. 0.5 mt/hr.	1 No.	Rs.	0.01
13. GENERAL SECTION			
1. Automatic weighing scale	2 Nos.	Rs.	0.02

14. 2. Workshop tools M/c and auxiliary	Rs.	0.01
15. Laboratory set-up with all equipment testing materials	Rs.	0.01
16. Electric Insulation charges	Rs.	0.01
17. Service facilities charges	Rs.	0.01
18. Other miscellaneous M/c as pipe, valve, cooling system, etc.	Rs.	0.01
19. Total Machineries Cost	Rs.	25,00,000.00

TOTAL	Rs.	25,00,000.19
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OTHER FIXED ASSETS

1.	Office equipment, furniture plus other equipment & accessories	Rs.	50,000.00
2.	Installation costs for water, electricity, fuel etc.	Rs.	2,00,000.00
3.	Pre-operative & preliminary expenses	Rs.	2,00,000.00
4.	Installation erection, commissioning	Rs.	4,00,000.00
5.	Technical Knowhow	Rs.	3,00,000.00
6.	Miscellaneous Expenses	Rs.	2,00,000.00
	TOTAL	Rs.	13,50,000.00

FIXED CAPITAL

1.	LAND & BUILDING	Rs.	88,50,000.00
2.	PLANT & MACHINERY	Rs.	25,00,000.19
3.	OTHER FIXED ASSETS	Rs.	13,50,000.00

	TOTAL	-----	Rs. 1,27,00,000.19	-----
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WORKING CAPITAL REQUIREMENT/MONTH

RAW MATERIALS

1.	Lime stone 220 MT @ Rs.1000/-per MT	Rs.	2,20,000.00
2.	Coal, Steam Coal 44 MT	Rs.	70,400.00
3.	Coke 70 MT @ Rs.2000/-per Mt (Incl. Transport)	Rs.	1,40,000.00
4.	Coal pitch, retort carbon and tar. Total 50 MT @ Rs.2000/-per MT (average)	Rs.	1,00,000.00
	TOTAL	Rs.	5,30,400.00

SALARY & WAGES / MONTH

1. Manager	1 No.	Rs.	15,000.00
2. Plant Supervisors	1 No.	Rs.	5,000.00
3. Electrical fitter	1 No.	Rs.	5,000.00
4. Mechanic	1 No.	Rs.	5,000.00
5. Furnace operators	2 No.	Rs.	8,000.00
6. Kiln operator	1 No.	Rs.	4,000.00
7. Chemists	1 No.	Rs.	6,000.00
8. Accountant	1 No.	Rs.	4,500.00
9. Typist/Clerk	1 No.	Rs.	3,500.00
10. Store Keeper	1 No.	Rs.	3,500.00
11. Time Clerk	1 No.	Rs.	2,500.00
12. Skilled workers	4 No.	Rs.	16,000.00
13. Unskilled workers	10 No.	Rs.	30,000.00
14. Security guards	1 No.	Rs.	2,500.00
15. Peon	1 No.	Rs.	2,500.00
	TOTAL	Rs.	1,13,000.00
Plus perks @ 33% p.a.		Rs.	37,290.00
	TOTAL	Rs.	1,50,290.00

UTILITIES AND OVERHEADS

1.	Power Consumption of 4000Kwatt hrs @ Rs. 4.50 per Kwatt hr.	Rs.	18,000.00
2.	Water Consumption of 500 KLs @ Rs. 2.00 per KL	Rs.	1,000.00
3.	Stationery, Postage, Telephone etc.	Rs.	5,000.00
4.	Conveyance & Transportation etc.	Rs.	7,000.00
5.	Publicity & Sales Promotion	Rs.	15,000.00
6.	Repairs & maintenance	Rs.	10,000.00
7.	Miscellaneous	Rs.	3,000.00
8.	Electrode consumption 3125 kgs. per month @ Rs.40/-per kg.	Rs.	1,25,000.00
9.	Packaging drum 50 kgs. each cap 3000 Nos. @ Rs.80/-per drum	Rs.	2,40,000.00
	TOTAL	Rs.	4,24,000.00

Total load is 22 Kwatts

TOTAL WORKING CAPITAL/MONTH

1. RAW MATERIAL	Rs.	5,30,400.00
2. SALARY & WAGES	Rs.	1,50,290.00
3. UTILITIES & OVERHEADS	Rs.	4,24,000.00

TOTAL	Rs.	11,04,690.00
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1. WORKING CAPITAL FOR 3 MONTHS	Rs.	33,14,070.00
2. MARGIN MONEY FOR W/C LOAN	Rs.	8,28,517.50

COST OF PROJECT

TOTAL FIXED CAPITAL	Rs.	1,27,00,000.19
MARGIN MONEY	Rs.	8,28,517.50

TOTAL	Rs.	1,35,28,517.69
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TOTAL CAPITAL INVESTMENT

TOTAL FIXED CAPITAL	Rs. 1,27,00,000.19
TOTAL WORKING CAPITAL FOR 3 MONTHS	Rs. 33,14,070.00
TOTAL	Rs. 1,60,14,070.19

COST OF PRODUCTION/ANNUM

1. Working Capital for 1 year	Rs. 1,32,56,280.00
2. Interest @ 12.00% on T.C.I.	Rs. 19,21,688.42
3. Depreciation @ 6.50% on buildings	Rs. 4,45,250.00
4. Depreciation @ 25.00% on Plant and Machinery	Rs. 6,25,000.05
5. Depreciation @ 20.00% on office equipment & furnitures	Rs. 10,000.00
TOTAL	Rs. 1,62,58,218.47

TURN OVER/ANNUM

1. By sale of calcium carbide 1200 MT
 @ Rs.16600/-per MT. Rs. 1,99,20,000.00

TOTAL Rs. 1,99,20,000.00

PROFIT = RECEIPTS - COST OF PRODUCTION
 = 1,99,20,000.00 - 1,62,58,218.47
 = 36,61,781.53

PROFIT SALES RATIO = Profit / Sales x 100
 = $\frac{36,61,781.53}{1,99,20,000.00} \times 100$
 = 18.38 %

RATE OF RETURN = Operating profit / T.C.I x 100
 = $\frac{36,61,781.53}{1,60,14,070.19} \times 100$
 = 22.87 %

BREAK EVEN POINT (B.E.P.)

Fixed Costs of the plant are as under -

1. Interests	Rs. 19,21,688.42
2. Depreciation	Rs. 10,80,250.05
3. 40.00% of salaries	Rs. 7,21,392.00
4. 40.00% of overheads	Rs. 20,35,200.00
TOTAL	Rs. 57,58,530.47

$$\begin{aligned}
 \text{B.E.P.} &= \frac{\text{FIXED COSTS}}{\text{FIXED COSTS} + \text{PROFIT}} \times 100 \\
 &= \frac{57,58,530.47}{57,58,530.47 + 36,61,781.53} \times 100 \\
 &= 61.13 \%
 \end{aligned}$$

$$\begin{aligned}
 \text{LAND MAN RATIO} &= \text{Total land / Manpower} \\
 4000 : 28 &:: 143 : 1
 \end{aligned}$$

RESOURCES FOR FINANCE

1.	Term loans from Financial institutions (65.00 % of fixed capital) at @12.00% p.a. rate of interest	Rs. 82,55,000.12
2.	Bank loans for 3 months (65.00 % of working capital) at @ 12.00% p.a. rate of interest	Rs. 21,54,145.50
3.	Self raised capital from even funds & loans from close ones to meet the margin money needs at a @ 12.00% p.a rate of interest	Rs. 56,04,924.57
	TOTAL	Rs. 1,60,14,070.19

INSTALMENT PAYABLE IN 5 YEARS

Year	To Financial institutions (Rs. 8255000)	To Commercial banks (Rs. 2154146)	To others (Rs. 5604925)	Total
1	16,51,000.02	4,30,829.10	11,20,984.91	32,02,814.04
2	16,51,000.02	4,30,829.10	11,20,984.91	32,02,814.04
3	16,51,000.02	4,30,829.10	11,20,984.91	32,02,814.04
4	16,51,000.02	4,30,829.10	11,20,984.91	32,02,814.04
5	16,51,000.02	4,30,829.10	11,20,984.91	32,02,814.04

INTEREST PAYABLE IN 5 YEARS

Year	On term loans (Rs. 8255000) @ 12.00 % P.A.	On bank loans (Rs. 2154146) @ 12.00 % P.A.	On self loans (Rs. 5604925) @ 12.00 % P.A.	Total
1	9,90,600.01	2,58,497.46	6,72,590.95	19,21,688.42
2	7,92,480.01	2,06,797.97	5,38,072.76	15,37,350.74
3	5,94,360.01	1,55,098.48	4,03,554.57	11,53,013.05
4	3,96,240.01	1,03,398.98	2,69,036.38	7,68,675.37
5	1,98,120.00	51,699.49	1,34,518.19	3,84,337.68

TOTAL REPAYMENT SCHEDULE FOR 5 YEARS

Year	Interest	Instalments	Total
1	19,21,688.42	32,02,814.04	51,24,502.46
2	15,37,350.74	32,02,814.04	47,40,164.78
3	11,53,013.05	32,02,814.04	43,55,827.09
4	7,68,675.37	32,02,814.04	39,71,489.41
5	3,84,337.68	32,02,814.04	35,87,151.72

DEPRECIATION CHART FOR 5 YEARS

Year	Building costs (Rs. 6850000.00) @ 6.50 % P.A.	Plant & Machinery (Rs. 2500000.19) @ 25.00 % P.A.	Fur. & office equip. (Rs. 50000.00) @ 20.00 % P.A.	Total
1	4,45,250.00	6,25,000.05	10,000.00	10,80,250.05
2	4,16,308.75	4,68,750.04	8,000.00	8,93,058.79
3	3,89,248.68	3,51,562.53	6,400.00	7,47,211.21
4	3,63,947.52	2,63,671.90	5,120.00	6,32,739.41
5	3,40,290.93	1,97,753.92	4,096.00	5,42,140.85

PROFIT ANALYSIS FOR 5 YEARS

YR	CAP UTIL	Sales	Mfg. Expenses	Gross Profit	Depreciation @ 38.85%	Interest before tax	Net profit after tax	Net profit
1	70%	13944000	9279396	4664604	1080250	1921688	1662666	1016720
2	80%	15936000	10605024	5330976	893059	1537351	2900566	1773696
3	80%	15936000	10605024	5330976	747211	1153013	3430752	2097905
4	90%	17928000	11930652	5997348	632739	768675	4595933	2810413
5	100%	19920000	13256280	6663720	542141	384338	5737241	3508323

CASH FLOW STATEMENT FOR 5 YEARS

YR	CAP. UTIL	Net profit (after tax)	Depreciation	Cash in hand	Repayment of Instalment	Net surplus
1	70%	1016720	1080250	2096970	2081829	15141
2	80%	1773696	893059	2666755	2081829	584926
3	80%	2097905	747211	2845116	2081829	763287
4	90%	2810413	632739	3443153	2081829	1361323
5	100%	3508323	542141	4050464	2081829	1968635

PROJECTED BALANCE SHEET FOR 5 YEARS

Construction Period	1 Yr. 70 %	2 Yr. 80 %	3 Yr. 80 %	4 Yr. 90 %	5 Yr. 100 %
	Cap. Util.	Cap. Util.	Cap. Util.	Cap. Util.	Cap. Util.

LIABILITIES

1. Promoters capital	56,04,924	56,04,924	56,20,065	62,04,991	69,68,278	83,29,602
2. Net Surplus	0	15,141	5,84,926	7,63,287	13,61,324	19,68,635
3. Term loans	82,55,000	66,04,000	49,53,000	33,02,000	16,51,000	0
4. W/C loans	21,54,145	17,23,316	12,92,487	8,61,658	4,30,829	0
TOTALS	1,60,14,069	1,39,47,381	1,24,50,478	1,11,31,936	1,04,11,431	1,02,98,237

ASSETS

1. W.D.V. of Fixed Asset	94,00,000	83,19,750	74,26,692	66,79,482	60,46,743	55,04,602
2. Working Capital in stock	0	23,19,849	26,51,256	26,51,256	29,82,663	33,14,070
3. Surplus funds	66,14,069	33,07,782	23,72,530	18,01,198	13,82,025	14,79,565
TOTALS	1,60,14,069	1,39,47,381	1,24,50,478	1,11,31,936	1,04,11,431	1,02,98,237