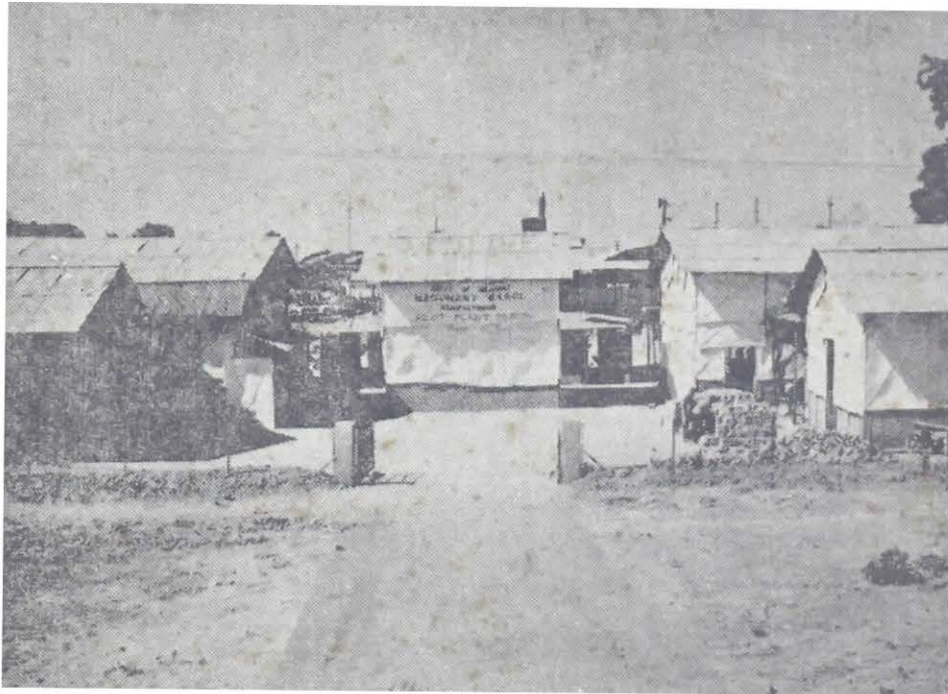


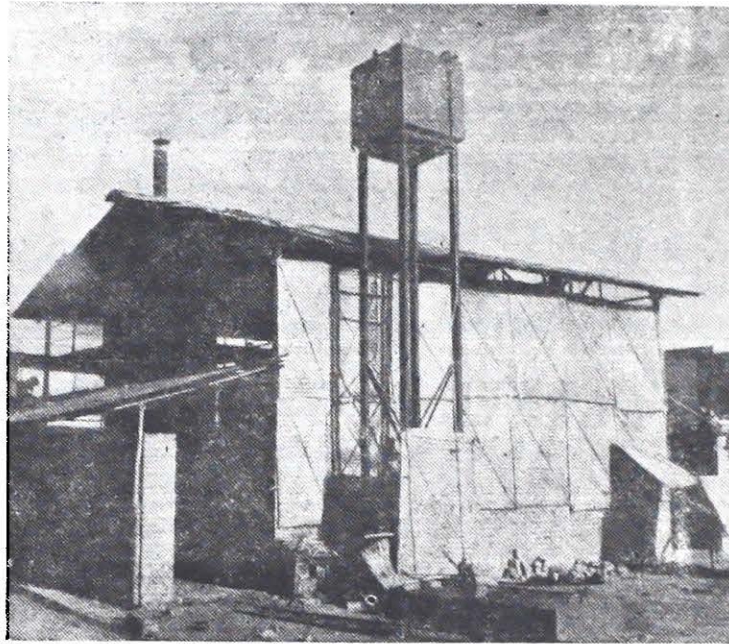
Accompaniment to the G. R., F. M. & P. D., No. RSP-1066 (Sagol)/3727-kh, dt. 12-8-'66.

REPORT
of the
ADVISORY COMMITTEE APPOINTED
for
**THE DESIGNING AND SETTING UP OF AN EXPERIMENTAL
PILOT PLANT FOR THE MANUFACTURE OF
MASONRY SAGOL**

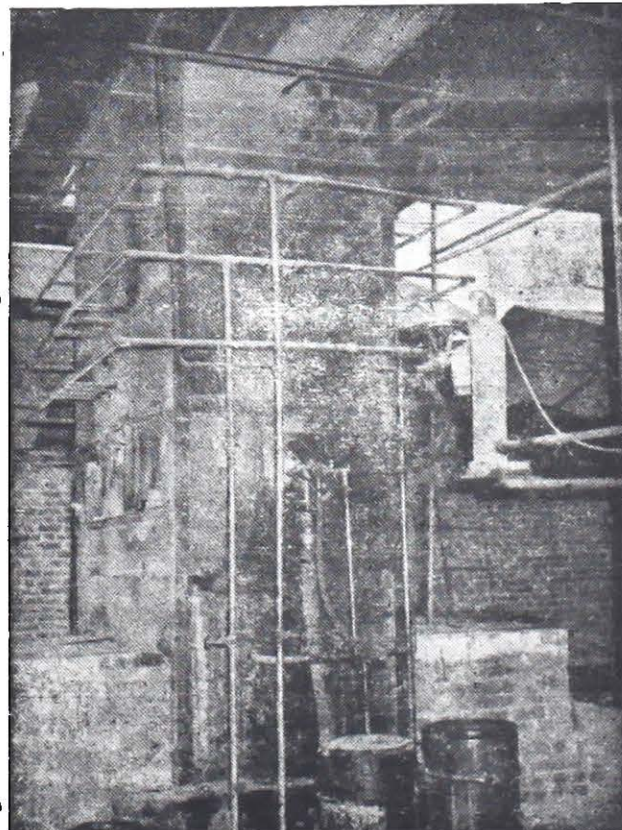


RAJKOT
GOVERNMENT PRESS
1967

R E P O R T
of the
ADVISORY COMMITTEE APPOINTED
for
THE DESIGNING AND SETTING UP OF
AN EXPERIMENTAL PILOT PLANT
for
Manufacture of: " MASONRY SAGOL "



**SPECIALLY DESIGNED KILN FOR
MANUFACTURE OF MASONRY SAGOL**



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FORMATION OF COMMITTEE

1. This Committee was appointed by the Government of Gujarat, in pursuance of their Rural Development Department Resolution No. RIP 1064 (Sagol)/U.O 1247-CHH, dated the 3rd November, 1964. The Committee consisted of the following :—

- | | | |
|----|--|------------------|
| 1. | Dr. C. B. Patel,
Ex-Director of Industries,
Gujarat State. | Chairman. |
| 2. | Prof. C. H. Khadilkar,
Poly Technic
M. S. University,
Baroda. | Member. |
| 3. | Shri S. H. Mehta,
Superintending Engineer (Irrigation),
Baroda. | Member. |
| 4. | Shri N. V. Ganpule,
Director,
Small Industries Service Institute,
Ahmedabad. | Member |
| 5. | Shri P. S. Dharwadkar,
Deputy Director of Industries,
Ahmedabad. | Member. |
| 6. | Shri C. A. Raval,
Deputy Director of Cottage Industries
(Training & Extension),
D. J. C. I. Institute,
Baroda. | Member-Secretary |

The terms of reference were to set up a pilot plant for modernizing the process of manufacturing improved Sagol and ascertaining the feasibility of establishing such a plant on small scale.

2. The members of the Committee are happy to state that they were able to reach unanimous conclusions and make unanimous recommendations as set out in their report which is submitted in the succeeding paragraphs.

P R E F A C E

The Research Hobby Club of the M. S. University, Baroda put forward a proposal to setup a pilot plant for manufacture of 'Masonry Sagol' of improved quality by adopting modern techniques. It was hardly imagined that the idea would crystallize soon and would develop into full scale establishment of a pilot plant. Shri J. G. Shah, Secretary to Government, Panchayat and Health Department took keen interest in this proposal and the same was submitted to the Planning Commission. There after, a Sub-Committee was appointed. After formation of the Sub-Committee and after getting its report, the Government sanctioned the necessary scheme as put up by the Ad Hoc Committee and delegated the full powers required for the setting up of the pilot plant. When the Project Committee required additional funds, the necessity was readily appreciated by Shri K. T. Satarawala, Secretary to Government, Industries, Mines and Power Department who got the funds sanctioned in the most expeditious manner possible. The implementation of the pilot plant scheme became a practical proposition thanks to the interest taken by Shri P. N. Dhar, Assistant Secretary, Planning Commission (R.I.P.) New Delhi, without whose encouragement the scheme would not have materialised so quickly.

The Project Committee wishes to record its deep sense of gratitude to Dr. C. S. Patel Vice-chancellor, M. S. University, Baroda for immediately agreeing to make available, the necessary land required for the project in the Polytechnic premises. The project could never have taken shape without the active support and co-operation of the M. S. University of Baroda.

We express our gratitude also to Shri H. M. Patel, Chairman, Gujarat Electricity Board Baroda and Shri Nanalal Chokshi, President, Baroda Borough Municipality for helping the Project Committee in various ways by making available the necessary facilities

Our sincere thanks are due to Shri S. M. Ghosh, Director of Industries, Gujarat State, Shri V. R. Mehta, Ex-Registrar of Co-operative Societies, Gujarat State and Shri H. M. Joshi, Present Registrar of Co-operative Societies for their valuable help in the execution of the project. We have also to place on record our appreciation of the keen interest taken by Dr. G. G. K. Shastri, Director of Geology and Mining and Shri N. V. Ganpule, Director, Small Industries Service Institute, Ahmedabad. Shri N. V. Ganpule left us to take up his assignment in Libiya.

We thank the management of M/s. Jyoti Limited, Baroda for giving valuable guidance in respect of procurement of plant and machinery.

Shri C. A. Raval, Deputy Director of Cottage Industries and Shri Pathak, Deputy Engineer, P. W. D., the executive Officers of the Project have done an excellent job in executing the project with utmost speed on the basis of various recommendations made by the Committee. They deserve our high appreciation.

The whole Project Team worked in a very co-operative and friendly atmosphere. This has resulted in our fulfilling the project and submitting this report within the time laid down by the Government.

CHAPTER I

Introduction

1.1. Thanks to the developmental and expansion activities on various fronts both by the public and private sector, the various types of construction activities have increased tremendously in the last few years. With the fast growth of population the housing accommodation has also become an acute problem, resulting in more and more building activities. On the other hand the present supply of various building materials such as cement, steel and iron bars and sheets is very inadequate to meet the total demand. Cement is the major material required for any type of building activity.

1.2. The country is facing an acute shortage of cement, and important building materials and this has resulted in the delayed execution of construction projects including housing programmes undertaken by various agencies like the housing boards, co-operative societies, factory owners, etc. The problem of cement shortage has attracted the attention of Planners, Economists and Scientists and different schemes have been proposed and undertaken to produce more cement, to economise the use of cement and to find out substitutes for it.

1.3. To economise the use of cement, the use of lime mortar has been advocated. Owing to the practice of using cement-lime mortar, advantage in the use of pure lime mortar has not received sufficiently wide appreciation with the result that the demand for cement is mounting. "Sagol", an improved or better variety of lime is traditionally produced in Gujarat and other places, and generally fetches better value as compared to ordinary lime. The production of "Sagol" is done in crude kilns without any scientific controls and the product obtained is probably better than ordinary lime, with a mixture of 'kankar'. The Research Hobby Club of Faculty of Technology and Engineering, M. S. University of Baroda, Baroda, worked on the problem of manufacture of "Masonry Sagol" an intermediate product between cement and lime by adoption of intermediate Technology. The word "Masonry Sagol" is used to differentiate the product to be produced in the Pilot Plant and the ordinary sagol at present produced in the crude way. On the basis of the experiments carried out by the Research Hobby Club, it recommended that it would be necessary to undertake pilot plant tests for developing a process to manufacture "Sagol" with definite composition on commercial scale and subsequently for recommending to small entrepreneurs to undertake the manufacture of "Masonry Sagol". The main object of this recommendation was to find out an intermediate product between cement and lime so that it could achieve the dual object of feeding the housing projects with a proper building material and utilising the small pockets of lime stone located at various places in the country.

1.4. The paper presented by the Research Hobby Club of the Faculty of Technology and Engineering, M. S. University of Baroda, Baroda, came before the planning Commission and Government of Gujarat, the State Government vide its Resolution, Rural Development Department No. R. I. P-1064 (Sagol) /23123-CHH dated the 5th September 1964, constituted a committee to examine the possibility of setting up of a pilot plant for modernizing the process of manufacturing "Masonry Sagol". This Committee, after having its deliberations presented a report to the State Government and recommended the installation of a pilot plant for the said purpose. The State Government accepted the recommendations of the committee and after consulting the planning Commission approved the scheme for setting up the pilot plant vide its Resolution No. R. I. P.—1064 (Sagol)/U. O. 1247-CHH dated the 3rd November, 1964. The Resolution, and the scheme prepared by the committee are reproduced as Appendix I, enclosed.

1.5. The Advisory Committee constituted for setting up the Pilot plant started its work in right earnest after its formation. The first meeting was held on 17th November 1964. The Committee held its deliberations 16 times for the purpose of speedy purchase and installation of the machinery and execution of the project as approved by the Government. The drawing up of the specifications of the machinery was done on the advice of the Research Hobby Club, and efforts were made to obtain

the machinery as quickly as possible by inviting quotations and by undertaking negotiations with machinery manufactures. The greatest problem of designing and erecting a proper Kiln was worked out with the technical advice of the Research Hobby Club. Along with the formulation of the specifications of the machinery, the problems of procuring suitable land and obtaining electric power, water connections and building construction materials for civil engineering works had to be tackled.

1.6. As the project was to be undertaken under the active guidance of Research Hobby Club, the Committee felt that it would be advisable to set up the project near the polytechnic. A suitable piece of land to the north of the polytechnic was made available by the University authorities. The University subsequently also made available the facility of drawing the necessary quantum of water for the project.

1.7. Owing to the shortage of electricity experienced in Baroda area at that time, it was not possible for the municipal authorities to grant the load immediately. However, the Government sanctioned the necessary load of 100 K.W. for the project. This was made available through the Baroda Borough Municipality. Though the electric load was sanctioned, acquiring of a transformer became a problem but the State Electricity Board came to our rescue and made available a 100 KVA Transformer on loan from Jamnagar.

1.8. In the initial project report submitted to the Government the total cost estimated was of the order of Rs. 1,90,000. The Government, however, sanctioned a sum of Rs. 1,75,000 and hence a further grant was asked for from the Government. After the placing of the orders for the plant and machinery, it was observed that the cost of plant and machinery would exceed the estimates, and hence an additional grant of Rs. 34,000 was requested. The Government vide Industries Department Resolution No. RIP-1065 (Sagol) / 62-KH, dated 27th April 1965 sanctioned the additional funds for the project. Copy of the said Resolution is attached as Appendix I(a).

1.9. Originally, the scheme was to be completed before the onset of monsoon but was delayed on account of various reasons. The scheme also envisaged the production of "Masonry Sagol" with only 20% cement content. The Operational Research of the Research Hobby Club showed that strict temperature control at various stages of the firing of the Kiln could increase the percentage of cement content in the "Masonry Sagol". The control of temperature necessitated purchase of Thermocouples and Pyrometers, etc. The position of the land on which the plant was installed, necessitated the construction of civil works for the protection of the plant during monsoon. The scheme was delayed in execution for non-availability of cement for the civil construction and installation of the plant, delay in getting electric connection and late receipt of certain machineries. In the original scheme certain machineries like Badami pallet Making Machine, pan Mixer and Vibrating Screen for the raw-mix, platform type weighing machine for the final product and for purchase of 400 drums for the storing of the "Masonry Sagol" etc. were not included. The additional plant and machinery and civil works construction involved an additional expenditure of Rs. 1,43,020. A proposal was submitted to Government on 8th June 1965 and the Government readily accepted the proposal and sanctioned the additional expenditure of Rs. 1,43,020 vide Industries, Mines and power Department Resolution No. RIP-1065 (Sagol)-6775-Kh, dated 31-7-1965, copy enclosed as Appendix 1(B).

CHAPTER II

Process and Installation of the plant

2.1. The Report of the Committee which recommended the setting up of the pilot plant, includes a rough outline of the process for the manufacture of "Masonry Sagol". The process recommended is to prepare a rawmix of the following composition from the available nearby reasources of the State

(i) CaCO_3	..	..	..	..	..75%
(ii) SiO_2	..	..	..	..	..14 to 20%
(iii) Al_2O_3	..	..	..	..	..6 to 8%
(iv) Fe_2O_3	..	..	..	..	..2 to 3%
(v) Mgo}	..	..	..	..	..Less than 4%

The Research Hobby Club of the M. S. University, Baroda was entrusted with the task of conducting operational research for the development of the process for manufacture of "Masonry Sagol". After carrying out various experiments it has recommended a Raw mix of the following compositions :

(i) CaO}	..	..	..	..	41 to 42%
(ii) SiO_2	..	..	..	..	13 to 14%
(iii) Fe_2O_3	..	..	..	..	1.8. to 2%
(iv) Al_2O_3	..	..	..	..	4 to 5%
(v) Impurities	..	..	..	..	Less than 5%

For achieving the best results for manufacturing "Masonry Sagol" with a 60% content of cement the above raw-mix is recommended. Thus it will be seen that the percentage of Iron and Alumina needs to be high with a lesser percentage of Silica as originally thought of. The Report of the research Hobby Club enclosed as Appendix II brings out complete details on the aspect of raw materials and composition involved in the production of "Masonry Sagol".

2.2. From the report of the Research Hobby Club, it will be seen that tests on limestone drawn from various sorces have been carried out and after carrying out the tests, the Club has recommended the limestone deposits of Kim, Ranoli, Chhota Udepur and Rajpipla to be excellently suitable for the production of "Masonry Sagol". Though these are considered to be the ideal resources, the fact remains that "Masonry Sagol" from other limestone deposits like Godhra can also be utilised for the manufacture of "Mansony Sagol". Perhaps, the cement content of the "Masonary Sagol" so produced may be slightly less.

2.3. Alongwith the experiments and operational reseaech undertaken by the Hobby Club on the various resources, it also undertook the work of designing of the Kiln and formulating the specifications of the plant and machinery for the pilot plant. Special mention has to be made to the designing of the pallet making machine and the Kiln. After undertaking experiments on the shapes and the sizes of the pallets, the Club came to the conclusion that pallets should be made of the shape and size of badami coal which is at present extensively used as domestic fuel. The second difficult task was the designing of the Kiln. After constructing various laboratory models, the Research Club prepared a working drawing and on the basis of the working drawing, the Kiln was set up.

2.4. In the report of the Committee which recommended the setting up of the pilot plant, a rough outline of the requirement of the machinery and plant was given. However a few changes in the specifications and capacity of the machinery and plant were found necessary on the basis of studies conducted by the Research Hobby Club. After finalization of the requirements of the plant and machinery, the main task was to obtain it as quickly as possible. According to the original scheme

approved by the Government, the whole project was to be completed before the onset of monsoon. Steps were taken to place the order for machinery in the month of February and practically all the machinery was received by middle of April. Unfortunately, owing to non-availability of electric power the tests on the machinery could not be undertaken.

2.5 With the difficulty experienced in procuring the transformer, the supply of electric power was delayed. After the installation of the transformer, the Project could get the electric power sometime in the middle of June 1965 and only thereafter the trials of the machinery installed, and the firing of the kiln was possible. It is gratifying that the machinery received gave the results as required. Details of the plant and machinery their specifications and the sources from where it was procured along with the photograph of each machinery are given in the Appendix No. III, enclosed.

2.6 After undertaking trials, it was found necessary to provide pyrometers and thermocouple for the kiln so as to arrange temperature control at various stages of the kiln. Before the Project was started, it was felt that the pallets of the raw-mix having definite chemical composition could be initially burnt in a normal continuous type of lime kiln with cinders. The burnt pallets were to be subsequently charged in an oil fired kiln for a particular period to obtain "Masonry Sagol". The operational research of the Research Hobby Club proved that it was not necessary to have two separate firings and both the processes could be undertaken in the same kiln and accordingly the kiln was designed.

2.7 With the above general background of the principles of processes involved, the details of the flow-sheet are narrated below :

(1) A complete layout plan of the Project is shown in Appendix IV, and the various processes involved are shown in the flow-sheet diagram shown in the Appendix V.

(2) After undertaking laboratory analysis on the limestone drawn from various resources, the percentage of limestone to be mixed is decided. The limestone of each source is crushed and ground to a mesh of about 30 through stone crusher, roller crusher and disintegrators. The ground material is stored separately in separate silos. On the basis of the analytical reports, the ground limestone from different silos is drawn, mixed and ground to a mesh of 100 in the ball mill. The grinding of the raw-mix in the ball mill takes about 30 minutes and this produces a homogeneous mass. The raw meal is subsequently charged to a pan-mixer with sufficient quantity of water and ground so as to give a workable mass for forming the pallets in the pallet making machine. The ground mass is taken to the pallet making machine where pallets are formed. The pallets are subsequently dried in sun for a day and stored in a pool-room. From the pool-room the pallets are taken to the charging room where they are mixed with a mixture of char-coal, slack-coal and bye-product hard coke. The mixture of the coal and coke is in the proportion of 1 part of char-coal, 4 parts of slack coal and 1 part of bye-product hard coke. This coal/coke mixture is prepared by crushing it to a size of about 1/2" to 1". The pallets and the fuel are mixed in the proportion of 9:1 respectively. In this way, the pallet charge is ready for loading in the kiln.

(3) The kiln designed is able to hold a total charge of about 5 tonnes. Before the initial firing, the kiln is filled with the pallet charge to a level, a little over the level of the burners. Over this pallet charge, a small bed of the coal/coke fuel is spread and the kiln is ignited with the help of the burners. After ignition of the burners, the kiln is filled with the mixed pallet charge upto the top. The burning of the char-coal takes place at a temperature of 350°C. The burning of the char-coal produces a temperature of 650°C. which ignites the slack coal and the burning of the slack-coal brings a temperature of about 850°C. at which stage the coke starts burning. After this stage is reached, the burners are shut off and the heavy burning of the coal/coke is allowed for a period of about 12 hours (overnight) at a temperature of about 950°C. Before the temperature is reached to 950°C. the burning of the burners is regulated

so as to have a temperature in the range of 900 C. and 1000 C. After burning all the charge at a temperature of 950 C. for a period of about 10 to 12 hours, the charge is ready for further burning to a temperature of 1300 C. to 1400 C. This is achieved by burning the burners and regulating the temperature with the aid of the thermocouple and pyrometers. The whole process of burning in the kiln can be explained as follows. The burning of the charge at 350 C. drives away the moisture, burning the charge between the temperature range of 400 C. to 700 C. for a period of two hours reduces Fe_2O_3 to Fe^o and burning it for 4 hours between the temperature of 800°C to 950°C drives away the carbon dioxide gas. The different elements are activated between the temperature range of 1100°C to 1200°C and clinkers are formed between the temperature range of 1300°C to 1400°C.

(4) After the formation of the clinkers, they are taken out at the rate of 50 Kgs. every 15 minutes. Simultaneously the kiln is loaded from the top with a pallet charge of 100 Kgs. The drawing out of the charge at the rate of 59 Kgs. 15 minutes is continued till about 2½ tonnes are taken out. Taking out of the 2½ tonnes material takes about 12 hours. Thus the whole process can be so adjusted that during the day time the drawal of the charge and loading of the kiln is continued while during the night the pallet charge is allowed to burn at a temperature of about 950°C.

(5) The burnt-out charge would give about 60% clinkers. These clinkers are taken to a silo where they are allowed to cool down and kept for 3 days. On the 4th day the clinkers are taken to the disintegrators to be disintegrated into 1/8" clinker size. These disintegrated clinkers are stored in a separate silo and then pulverised to 200 mesh, collected in drums, weighed and packed and subsequently stored. While pulverising, 2 to 3% gypsum is added so as to regulate the setting period of the final product.

2.8. The above process produces the "Mansory Sagol" with a 60% content of cement. The speed with which the linkers are drawn from the kiln would increase or decrease the cement content in the final Sagol. If the drawl of the clinkers is slow, the cement content would increase and if the drawal of the clinkers is hastened, the cement content in the final Sagol would decrease. The normal process described above gives a product which has about 60% of the strenght of the standard cement, This product sets within reasonable time and has good workability and can be used in the ratio of 1:6 in the mortar of masonry work. Thus the product produced in this Pilot Project is an intermediate product between lime and cement and can be freely used in the building trade for all the works except, R. C. C.

CHAPTER III

Cost Structure

3.1. In the initial project report prepared by the Ad-hoc Committee the Government sanctioned an amount of Rs. 1,75,000 as per details given in Appendix I, On subsequent proposals made by the Advisory Committee, the Government sanctioned additional funds of Rs. 54,000 and Rs. 1,43,020 as detailed in Appendices I (a) & (b). Thus the total grants sanctioned for the project are as shown below :—

A. Non Recurring :		Rs.
(1) Land .. .. .	.. .. .	—
(2) Civil Engineering works .. .. .	.. .. .	51,200.00
(3) Plant and Machinery .. .. .	.. .. .	1,51,000.00
(4) Grant to M.S. University of Baroda .. .. .	.. .. .	15,000.00
	Total A ..	<u>2,17,200</u>
B. Recurring :		
(1) Purchase of Raw materials and fuel .. .. .	.. .. .	71,000.00
(2) Contingencies		
(a) Technical Staff & Labour .. .. .	.. .. .	30,000.00
(b) Electric and water charges .. .. .	.. .. .	14,000.00
(c) Other expenses .. .. .	.. .. .	10,000.00
(3) Administrative staff .. .. .	.. .. .	9,820.00
	Total B ..	<u>1,34,820</u>
	Total of A & B..	<u>3,52,020</u>

3.2. Against a total sanctioned provision of Rs. ,352,020 a sum of Rs. 2,53,904 has been spent upto the end of October 1965 as detailed below :—

A. Non Recurring :		
(1) Land .. .. .	.. .. .	Nil
(2) Civil Engineering works .. .. .	.. .. .	51,792.00
(3) Plant and Machinery .. .. .	.. .. .	1,29,236.00
(4) Grant to M.S. University of Baroda .. .. .	.. .. .	15,000.00
	Total A ..	<u>1,96,028.00</u>
B. Recurring :		
(1) Purchase of raw materials and fuel .. .. .	.. .. .	14,839.00
(2) Contingencies :		
(a) Techinal Staff & labour .. .. .	.. .. .	16,671.00
(b) Electric and water charges .. .. .	.. .. .	900.00
(c) Other expenses .. .. .	.. .. .	19,188.00
(3) Administrative staff .. .. .	.. .. .	10,932.00
	Total B ..	<u>62,530.00</u>
	Total of A & B ..	<u>2,58,558.00</u>

3.3. As the process of manufacture of "Masonry Sagol" has now been more or less standardized, regular production of about 100 tons of "Masonry Sagol" would be undertaken for demonstration of the plant during the next 2½ months. For the production of these 100 tons of "Masonry Sagol" during the next 2½ months, the following expenditure is estimated.

Recurring :	Rs.
(1) Purchase of raw materials nad fuels	3,000.00
(2) Contingencies :	
(a) Technical staff and labour	9,000.00
(b) Electric and water charges	*12,000.00
(c) Other expenses	10,000.00
(3) Administrative staff	7,000.00
Non-Recurring Civil works	3,000.00
Total	<u>44,000.00</u>

*Electric bills to be paid from June 1965 onwards.

3.4. Thus the total expenditure to be incurred on the scheme would be of the order of Rs. 3,02,558 and a saving of Rs. 49,462 is expected from the total sanction of Rs. 3,52,020.

3.5. The Government has allowed the sale of the "Masonry Sagol" produced in the plant on cash payment basis at a price not less than Rs. 5 per 50 Kgs. ex-delivery at the plant gate. On account of the present shortage of cement, it is expected that the "Masonry Sagol" produced in the plant would fetch a price of Rs. 8 to Rs. 10 per 50 Kgs. ex-plant gate. This would bring sale proceeds between Rs. 16,000 to Rs. 20,000

3.6. With the tests carried out, the following results have been achieved.

(1) Successful designing and installation of the kiln and installaion of the plant, machinery for the production of "Masonry Sagol" with a cement content of 60%.

(2) The product so produced has 60% strength of the standard cement. It sets within a reasonable time and can be used in the ratio of 1:6 in the mortar in the masonry work and can be considered as an intermediate product between lime and cement.

(3) On the basis of the installation of the pilot plant an experience gained, a model scheme is recommended for establishment of small scale "Masonry Sagol" plant with a capacity of 10 tons per day (Appendices VI, VIA, VIB & VIC).

CHAPTER IV

Observations and Recommendations

4.1. From the preceding Chapters, it will be observed that the original idea conceived by the Research Hobby Club of M. S. University, Baroda; to set up a plant to manufacture sagol of definite qualities, crystallized after the setting up of the pilot plant and it has been proved beyond doubt that a project undertaken on the lines of the pilot plant can produce "Masonry Sagol" of definite structure and qualities. The material so produced will be an intermediate product between cement and lime and can be used for all construction purposes except R. C. C.

4.2. The whole plant and machinery can be fabricated indigenously and untapped resources of the country can be fruitfully utilised to solve the housing problem.

4.3. The process for manufacture of "Masonry Sagol" in a project to be undertaken on the lines of this pilot plant would be simple and such a plant can be set up in rural areas.

4.4. The Director of Geology and Mining, Government of Gujarat has supplied a note on limestone deposits of the State. The note is reproduced as Appendix VII, enclosed. From this data it can be seen that there are a large number of limestone deposits in the State for feeding economic cement plants, there are also certain small pockets of deposits of limestone which can be exploited by a project to manufacture "Masonry Sagol" on the basis of the scheme for producing 10 tons of sagol per day as outlined in the model scheme as detailed in Appendices VI, VIA, VIB, VIC.

4.5 Establishment of such small units all over the country will open a new field of activity and this will go a long way in achieving one of the basic objectives to decentralise the basic industries.

4.6. The production of "Masonry Sagol" in the rural areas would meet the demand of essential building material for housing programme and the saving in the consumption of cement thus accrued, can be utilised for more important and bigger projects where R. C. C. construction has got to be done.

4.7. "Masonry Sagol" produced in such plants can be utilised in the ratio of 1:6 in the mortar of masonry work, and this can introduce a new concept in rural housing programme. If the production of cheap roofing material like Mangalore type of tiles which can again be produced from the local resources, is undertaken, the rural housing programme will not depend on any commodity which cannot be produced from local resources.

4.8. The 10 tons per day plant recommended in Appendices VI to VIC be installed in the small scale sector.

4.9. The cost of the plant and machinery for 10 tons plant would be of the order of Rs. 2½ lakhs. The fabrication of the plant and machinery can be standardised and this will provide new employment opportunities in the engineering sector. With more experience gained in the fabrication of plant and machinery, the cost of this item may perhaps be reduced and thereby the cost of production of "Masonry Sagol" may also be lowered.

4.10. The development of this industry is likely to serve as an embryo for the establishment of cement industry in the small scale sector in future.

4.11. We recommend that the State Government and the Government of India give wide publicity to the establishment of this pilot plant and invite entrepreneurs to see it and persuade small entrepreneurs to establish it in the rural sector. It is recommended that Government may take appropriate steps to encourage the

establishment of these plants in the co-operative sector as done for the sugar industry and spinning mills because such co-operative ventures can help the housing programme under taken by co-operative societies. The establishment of these plants in the co-operative sector should get the same technical and financial assistant as is made available to the co-operative spinning mills.

4.12. We recommend that the Work of Professor C. H. Khadilkar and the Research Hobby Club. M. S. University, Baroda, should be appreciated and recognized as an outstanding achievement in 1965 in the applied research field. We also recommend that Professor C. H. Khadilkar should be appointed as an Advisor/Consultant to guide the establishment of such plant.

(Sd.) C. B. Patel

(,,) C. H. Khadilker

(,,) S. H. Mehta

(,,) M. K. Chitre

(,,) P. S. Dharwadkar

(,,) C. A. Rawal

APPENDIX I

*Rural Industries Project, Godhra,
District Panchmahals*

Sanction of Scheme relating to
designing and setting up of an
experimental pilot plant for manu-
facture of improved 'SAGOL'

GOVERNMENT OF GUJARAT

Rural Development Department,

Resolution No. RIP 1064 (Sagol) U. O.1247-CHH.,

Sachivalaya, Ahmedabad-15, dated the 3rd November, 1964

Read : D. O. letter No. RIPC/6(4)64, dated 30-7-1964 from Shri P. N. Dhar, Assistant Secretary, Rural Industries Planing Committee, Planning Commission, New Delhi.

Government Resolution, Rural Development Department, No. RIP. 1064 (Sagol)/23123-CHH, dated 5-9-1964.

Letter dated 21-9-1964 from the Chairman 'Sagol' Committee, Baroda.

Letter No. RIPC/6(4) 64, dated 21-10-1964 from the Government of India Planning Commission, Rural Industries Planning Committee, New Delhi.

RESOLUTION

Government has, under Government resolution Rural Development Department No. RIP-1064 (Sagol)/23123-CHH, dated the 5th September, 1964, constituted a Committee to examine the possibility of setting up of a pilot plant for modernising the process of manufacturing improved "Sagol" and for preparing a scheme to put up a pilot plant at Baroda. Accordingly, the Committee has examined the possibility and drawn up a detailed scheme to put up an expermenral pilot plant for modernising the process of manufacturing improved 'Sagol' and submitted to the Government for approval. Since this is a centrally sponsored scheme and funs for the scheme are to be porvided by the Central Government (Planning Commission) as an outright grant it was necessary to obtain concurrence of the planning Commission before sanctioning the Scheme. Accordingly the concurrence of the Planning Commission was sought for and they have conveyed their concurrence under their letter No. RIPC./6(4)/64, dated 21-10-1964.

Government is now, pleased to sanction the Scheme relating to designing and setting up of the experimental pilot plant for manufacturing of improved 'Sagol', as detailed in the accompaniment for a period upto 31-3-1965 in the first instance.

2. The Scheme of the pilot plant should be implemented departmentally with the assistance of the advisory Committee constituted under the Government Resolution, referred to in para 1 above. The Deputy Director of Cottage Industries (Training and Extension), D.J.C.I. Institute, Baroda should be incharge of the Project in addition to his own duties and for this purpose Government is pleased to sanction a conveyance allowance of Rs. 50 per month, to him for such time as the project 'operates at Baroda as a special case, not to be quoted as a precedent.

3. The Deputy Director of Cottage Industries (Training and Extension), D.J.C.I. Institute, Baroda should have full powers in all respects including powers—

(i) To implement the project utilising properly the funds placed at his disposal,

(ii) To purchase tools, equipments, machinery, plants etc. without purview of the Central Store Purchase Officer either by inviting quotations and/or by inviting tenders from firms or manufacturers dealing with the items required, on such terms and conditions as may be felt necessary and purchase the goods after proper inspection regarding quality, specifications etc.,

(iii) To meet the requirements of the transport for carrying machinery, goods, raw materials etc. by engaging public transport vehicles by obtaining quotations or making enquiries as usual,

(iv) To recruit and appoint trained and untrained persons on temporary basis required for the project work,

(v) To determine and engage the staff/labourers etc. on daily wages,

(vi) To dispose of "Sagol" so produced,

and the various rules and orders relating to financial and other powers should be deemed to be modified to that extent.

4. Government is also pleased to sanction and place at the disposal of the Deputy Director of Cottage Industries (Training and Extension) D.J.C.I. Institute, Baroda a total grant of Rs. 1,75,000 (Rupees one lakh and seventyfive thousand only) for implementation of this project. He is authorised to draw and disburse grant.

The amount of the grant should be drawn by him and kept in the Personal Ledger Account. However, the account of the expenditure incurred in respect of this project should be kept separately and will be subject to Government audit.

5. Government is further pleased to direct that out of the total grant of Rs. 1,75,000 the Deputy Director of Cottage Industries (Training and Extension), D. J. C. I. Institute, Baroda; should sanction and disburse a grant of Rs. 15,000 (Rupees Fifteen thousand only) or the actual expenditure incurred on purchase of tools, laboratory instruments, chemicals, stores, etc. meant for the use of the pilot project, whichever is less to the Research Hobby Club of the M. S. University, Baroda; for conducting operational research for the development of the process for manufacturing 'Sagol' simultaneously. The club should, however keep separate account for this expenditure and carry out the laboratory testing work under the guidance and supervision of Dr. Khadilkar.

The Club should, in regard to the future use of the equipment which may be bought by it from out of the grant in-aid, be Government by the usual grant-in-aid rules in regard to the disposal of such equipment.

6. The Public works department should be requested to spare one Deputy Engineer and post him temporarily for this project on his grade pay and such allowances as he may already have been receiving, which are not in the nature of Special Pay.

7. The masonry construction material 'Sagol' so produced should be passed on by the Deputy Director of Cottage Industries (Training and Extension), Baroda to the Superintending Engineer, Public Works Department (Irrigation) Baroda who would arrange to sell the same to the public works department contractors and others on cash payment of price not less than Rs. 5 per 50 K. Gs. ex-delivery at the pilot plant gate.

The sale proceeds should be credited to the Government as receipts under the head "XXIX-Industries-B-Cottage Industries receipts from Cottage Industries."

However, in obtaining assistance from the Planning Commission, the amount of the receipts should be deducted from the expenditure incurred on the Scheme.

8. The Committee constituted under Government Resolution, Rural Development, Department, No. RIP. 1064 (Sagol)/23123-CHH, dated 5-9-1964 should function as an Advisory Committee for the project period. The members of the Committee are as under;

1. Dr. C. B. Patel, Chairman.
Ex-Director of Industries,
2. Prof. C. H. Khadilkar,
Poly Technic, M. S. University,
Baroda.
3. Shri S. H. Mehta,
Superintending Engineer (Irrigation),
Baroda.
4. Shri N. V. Ganpule,
Director of Small Industries,
Service Institute,
Ahmedabad.
5. Shri P. S. Dwarwadkar,
Deputy Director of Industries,
Ahmedabad.
6. Shri C. A. Raval, Member-Secretary.
Deputy Director of Cottage Industries
(Training & Extension),
D. J. C. I. Institute, Baroda.

The non official members of the Committee should be eligible to draw travelling allowance and daily allowance as per rule I (i)(b)(II) of Section I of the Appendix XLII-A, of the Bombay Civil Services Rules Vol. II, and the non-official local member will be eligible for conveyance charges actually incurred upto a maximum limit of Rs. 3 (Rupees three only) per day for attending the meeting and inspecting the working of the Pilot plant, as per rule 15-A of Section II to Appendix-XLII-A of the Bombay Civil Services Rules Vol. II.

9. In order to facilitate quick withdrawals and disbursements the Deputy Director of Cottage Industries (Training and Extension), Baroda should be permitted to draw moneys on abstract bills for payments of amounts to be classified as contingencies and account for them by the submission of detailed bills in due course. He should be the countersigning officer for the details bills. He should be the authority to draw and disburse in the usual manner the pay and allowances of the staff including those of the Deputy Engineer. He should be the authority for countersigning and also for sanctioning the amounts in respect of the bills furnished by the non-official members of the advisory committee. He should also be the Head of Department for all the staff including the Deputy Engineer engaged for the implementation of the project.

10. After the construction of the necessary worksheds and installation of the machinery etc. the production activities should be carried out for about a period of six months or for the period is necessary-whichever is less and thereafter the position in regard to the technical feasibility, economic viability and exact properties of the end product should be reviewed with the help of the Committee by the Deputy Director of Cottage Industries, (Training and Extension), Baroda with a view to determining the future scope of the project.

If the review shows successful conclusion of the experiment, the plant should be dismantled at Baroda and reinstalled in the Rural Industries Project, Panchmahals near about the location of the rawmatrrials.

11. The Deputy Director of Cottage Industrides, (Training and Extension), Baroda should regularly submit to the Planning Commission through the Government a brief monthly report in regard to the progress of the pilot project on 5th of each month.

12. The expenditure on this account is debitable to the head "35-Industries-B-Cottage and Small Scale Industries B-25(A) Scheme for Intensive Dvelopment of Small Industries in Rural areas" and should initially be met from the advance drawn from the contingency fund sanctioned under Government Memorandum Finance Department No. CNF.1164/785-K, dated 7-11-1964.

13. The Registrar, Cooperative Societies, Ahmedabad should be requested to submit to Government necessary proposal for reappropriation or the supplementary demand, as the case may be, at the appropriate time, positively.

14. This issues with the concurrence of the Health and Industries Departmen Finance Department, dated 28-10-1964 and 31-10-1964 respectively on this Departmen file No. RIP. 1064 (Sagol) U. O. 1247-CHH.

By Order and in the Name of the Governor of Gujarat
J. G. SHAH,
Secretary to the Government of Gujarat,
Rural Development Department.

To :

The Registrar, Co-operative Societies, Ahmedabad,
The District Development Officer, Godhra,
The Project Officer, Rural Industries Project, Godhra,
The Deputy Director, Cottage Industries (Training & Extension) D.J.C.I. Institute,
Baroda.
All members of Advisory Committee,
The Health and Industries Department,
The Public Works Department,
The Finance Department (V. Branch),
The Rural Development Department (Finance Branch),
The Rural Development Department (Book Circular),
The Rural Development Department (K. Branch),
The Director of Information, Ahmedabad with a request to issue press note,
The Director of Industries, Ahmedabad,
The Personal Assistant to Deputy Minister (P),
The Personal Secretary to Minister (P).
The Personal Secretary to Chief Minister,
The Joint Secretary to the Government of India,
Planning Commission, (Rural Industries Planning Committee),
Yojana Bhavan, New Delhi, (By letter).
The Select File.

Accompaniment to the G. R., R.D.D., No. RIP-1064 (Sagol)/U. O. 1247-Chh, dated 3-11-1964.

A SCHEME TO INSTALL A PILOT PLANT FOR MANUFACTURING MASONRY CONSTRUCTION "SAGOL" WITH A DAILY PRODUCTION OF 7 TONS (24 HOURS)

Introduction

Cement, an important building material, is in short supply. Many of the works, both in public and private sectors, specially the housing programmes are being handicapped for non-availability of this material. The builders are, therefore forced to use any material which is readily available in the market, "Sagol" has come in the building trade and is being extensively used for plastering etc., in building construction. The demand for this material is so great that it is becoming a small industry in urban towns. The process, however, followed in the manufacture of "Sagol" is crude that it is incapable of giving a reliable building material of definite properties.

The Research Hobby Club of the Faculty of Technology and Engineering, M. S. University, Baroda, has worked on the problem and suggested a procedure of manufacture by adoption of intermediate technology a standard quality of masonry construction "Sagol".

OBJECTS :

Before developing this process of manufacture of "Sagol" on commercial scales and before it can be recommended to all small entrepreneurs it is necessary to carry out tests on pilot plant basis with a view to ascertaining the quality of the "Sagol" to be produced by the process recommended by the Research Hobby Club of the Faculty of Technology and Engineering M. S. University, Baroda and also to work out the economic cost of the production of "Sagol". Though it is mentioned that it is a pilot plant test, in fact, it would be a full fledged plant to undertake the production on commercial basis for a duration of 3 months with the plant and machinery of such capacity for running a regular "Sagol" manufacturing unit.

SCHEME :

The detailed scheme for establishment of the pilot plant is as under :—

1. Process :

- (a) In this process, the limestone available from Panchmahal district as well as from other suitable parts of the State would be utilised. The limestone and the earth available would be analysed, if necessary, in the Industrial re-Research Laboratory, Department of Industries, Baroda and mixed in such production as to have a chemical composition given below :

(i)	CaCO ₃	..	..	..	..	..	75 %
(ii)	SiO ₂	..	..	..	..	..	14% to 20%
(iii)	Al ₂ O ₃	..	..	..	..	..	6% to 8%
(iv)	Fe ₂ O ₃	..	..	..	..	..	2% to 3%
(v)	MgO	..	..	..	..	..	Less than 4%

- (b) The raw mix is powdered to a fineness so as to pass through a 52 No mesh. The raw meal finely mixed is moistened with water and converted into pallets by hand process.
- (c) Then pallets which are nothing but limestone having definite chemical composition of the best hydraulic limestone are burnt in normal continuous type of lime kilns with cinders.

- (d) The burnt pallets are collected and charged into a specially designed oil-fired furnace to maintain a soaking temperature of about 1400°C.
- (e) The clinkers as formed are taken out in a continuous process and allowed to cool. They are then powdered with 4% gypsum so as to pass through 172 No. mesh sieve and are to be bagged and to be sold as masonry construction "Sagol".

To carry out this process on a pilot plant basis, an expenditure of Rs. 1-75 less would be involved which is roughly grouped under the following heads :

- (a) Land
- (b) Buildings
- (c) Machinery, tools and implements.
- (d) Recurring cost
- (i) Supervisory cost
- (ii) Establishment
- (iii) Raw materials
- (iv) Contingency

(a) *Land*.—The pilot plant unit is proposed to be set up in an open land between the Poly Technic and the Tara Nivas Bungalow-M. S. University area. The M. S. University would be requested to make available the land for carrying out this pilot plant test and it is presumed that the University would be willing to allow this land to be utilised for this purpose without charging anything for the same. A site plan showing the rough layout of the plant is enclosed.

(b) *Building*.—A temporary structure with about 2000 sq. ft. area would be erected to house the plant. It is proposed that a tubular structure would be erected so that it can be transported safely whenever required in future and can be utilised at any other place. The cost involved would be Rs. 20,000 approximately. Apart from the structure, an amount of Rs. 15,000 would be required for construction of internal roads within the plot area for arrangement of water supply, drainage and open plinth verandahs and silos for stacking of the materials. Similarly, an amount of Rs. 4,000 would be required for other civil engineering works such as fencing, watchman shed etc.

Thus the total amount involved would be Rs. 39,000 on building, and civil works.

(c) *Machinery, tools and implements*.—A flow diagram showing the process of manufacturing "Sagol" is enclosed. Following plant and machinery would be required for the purpose.

	<i>Amount.</i>
(1) Stone crusher capacity 1 ton per hour H. P. required 10 H.P. ..	6,500
(2) Disintegrator, capacity 1 ton per hour H. P. required 5 H. P... ..	2,000
(3) Floor mill (carborandum type)	2,000
(4) A pug mill with pallet making gadget.. .. .	6,000
(5) Primary Kiln	4,000
(6) Oil-fired secondary kiln with oil firing tanks, equipment etc. of a special design	35,000
(7) Ball mill 5 tons capacity to grind 50 to 100 mesh.. .. .	12,000
(8) Pulverising mill to grind 200 mesh H. P. required 30 H. P... ..	16,000
(9) Electric motors	7,500
(10) Erection charges	5,000
Total.. ..	96,000

In addition to the above mentioned non-recurring expenditure, the Research Hobby Club of the M. S. University, Baroda would be given a grant of Rs. 15,000 for conducting operational research for the development of the process for manufacturing "Sagol" simultaneously. This grant would be made available for purchase of equipment etc, and for other operational expenses. The grant would be made available to the M. S. University Baroda with a condition that the University would render necessary accounts to the Government in respect to the expenditure incurred by the University.

(d) *Recurring cost : (i) Supervisory Cost and (ii) Establishment.*—The pilot plant would be installed and worked under the overall supervision of the Deputy Director of Cottage Industries (Extension and Training), Dimaond Jubilee Cottage Industries Institute, Baroda. As he will be doing this work in addition to his normal duties, it is proposed that he may be given a conveyance allowance of Rs. 50 per month for meeting the conveyance charges. This conveyance allowance should start from the date the scheme is sanctioned by the Government.

It is also proposed to appoint a full time supervisor for installation of the plant. It is proposed to obtain the services of a Deputy Engineer, Public Works Department on his grade pay and such allowance as he may already have been receiving which are not in the nature of special pay. His services should be made available to the project from 1st November, 1964. Apart from these officers, it would be necessary to appoint suitable staff consisting of an accountant, a store-keeper, a clerk, a peon, watchman and skilled workmen to operate the plant and un-skilled labourers. The recruitment of these people and the remuneration to be given to them would be decided by the Deputy Director of Cottage Industries (Extension and Training), Baroda, which is proposed to be appointed for this purpose and about which details have been given hereafter. The total expenditure involved on the staff including salary of the Deputy Engineer but excluding the conveyance allowance to be given to the Deputy Director of Cottage Industries (Extension and Training), Baroda would amount to Rs. 12,000.

(iii) *Raw materials.*—The following raw materials would be required for producing 500 tons of "Sagol" :

(a) Limestone of desired quality	.. .. .	750 tons.
(b) Clay	.. .. .	25 tons.
(c) Furnace oil	.. .. .	25 tons.
(d) Cinders	.. .. .	400 tons.
(e) Gypsum	.. .. .	20 tons.

The approximate cost involved in purchase of the above materials is expected to be 22,000.

(iv) Contingency and miscellaneous expenditure including transport cost, travelling, stationery postage etc. Rs. 6000.

SUMMARY :

The total cost involved in running the scheme would be as under :

Non-Recurring :

(1) Land	.. .. .	Nil.
(2) Land and Civil Engineering Works	.. .. .	Rs. 39,000
(3) Land and Machinery	.. .. .	Rs. 96,000
(4) Grant to M. S. University, Baroda	.. .. .	Rs. 15,000
		Rs. 1,50,000
Total-non-recurring cost	.. .. .	Rs. 1,50,000

The recurring cost involved to produce 500 tons of "Sagol", within a period of 3 months would be Rs. 40,000 i.e. Rs. 80 per ton. Out of this Rs. 25,000 will have to be advanced. Thus the total of Recurring and Non-recurring would amount to Rs. 1,75,000.

APPENDIX I (a)

Rural Industries Project, Ghodhra,

Schme relating to designing and setting up of an experimental pilot plant for manufacture of improved 'Sagol' continuance for the year 1965-66.

GOVERNMENT OF GUJARAT,
Industries Department,
Resolution No. RIP-1065 (Sagol)/62-Kh,
Sachivalaya, Ahmedabad-15, Dated the 27th April, 1965.

*Read :—*Government Resolution, Rural Development Department No. RIP-1064/ (Sagol)/40-1247-Chh, dated the 7-11-64, letter No. DJCI/Sagol/605, dated the 18-3-65 from the Deputy Director of Cottage Industries (Training and Extension), Baroda.

RESOLUTION

Government is pleased to direct that the scheme relating to designing and setting up of an experimental pilot plant for manufacture of improved 'Sagol' sanctioned under Government Resolution, Rural Development Department No. RIP-1064 (Sagol) U. O. 1247-Chh, dated the 7-11-64 as detailed below should be continued further for the period ending 31-3-1966 or upto the date on which the plant is dismantled and transferred to the Panchmahals District, whichever is earlier.

Details of Expenditure—

							Rs.
1. Establishment	..	..	..	..	..	..	9,820
2. Raw-materials	..	..	..	..	..	..	11,000
3. Contingency	..	..	..	..	..	..	13,180

					Rs.
(a) Technical staff	..	..	..	..	9,000
(b) Electrical and water charges	..	..	..	..	1,500
(c) Other expenses	..	..	..	..	2,680

Total .. 13,180

Grand Total .. 34,000

2. Government is also pleased to sanction a conveyance allowance of Rs. 50 P. M. to the Deputy Director of Cottage Industries (Training and Extension), Baroda for such time as the project operates at Baroda, as a special case.

3. The Deputy Director of Cottage Industries (Training and Extension) D. J. C. I., Baroda should have all powers as mentioned in various paras of the Government Resolution, Rural Development Department No. RIP-1064 (Sagol) U. O. 1247-Chh, dated the 7-11-1964.

4. Government is also pleased to sanction and place at the disposal of the Deputy Director of Cottage Industries (Training and Extension), Baroda a grant of Rs. 34,000 (Rupees thirtyfour thousand only) for implementation of the project. He is authorised to draw and disburse grant, as and when felt necessary.

He should, however, keep account of the expenditure incurred in respect of this project separately which will be subject to the Government audit,

5. The expenditure on this account is debitable to the head "35 Industries-B-Cottage and Small scale Industries B. 25(A) scheme for intensive Development of Small Industries in Rural areas" and should be met from the overall saving under the head "35-Industries-B-Cottage Industries" by way of reappropriation during the current financial year.

6. This issues with the concurrence of Financial Adviser, dated the 14-4-65 on this Department file No. RIP-1065 (Sagol)/62-Kh.

By Order and in the Name of the Governor of Gujarat.
S. C. SHELAT,
Deputy Secretary to the Government of Gujarat,
Industries Department.

To,

The Registrar, Co-operative Societies, Ahmedabad.
The District Development Officer, Godhra.
The Project Officer, R. I. P., Godhra.
The Deputy Director of Cottage Industries (Training and Extension), D. J. C. I.
Baroda,
All members of the 'Sagol' Advisory Committee (through the Deputy Director
of Cottage Industries, Baroda)

The Industries Department (Gh. Br.)
The Public Works Department.
The Director of Industries, Ahmedabad.
The Personal Assistant to Deputy Minister (P)
The Personal Secretary to Minister.
The Private Secretary to Chief Minister,
The Joint Secretary to the Government of India, Planning Commission (Rural
Industries Planning Committee) Yojana Bhavam, Parliament Street,
New Delhi.

The Select file.

APPENDIX I (b)

Rural Industries Project, Godhra

Scheme relating to designing and setting up of an experimental pilot plant for manufacture of improved 'Sagol' Sanction of additional funds.

GOVERNMENT OF GUJARAT
Industries, Mines and Power Department,
Resolution No. RIP-1065 (Sagol) 6775-Kh,
Sachivalaya, Ahmedabad-15. Dated the 31st July, 1965.

Read.—Government Resolution, Industries Department, No. RIP-1065(Sagol)/62-Kh, dated 27-4-1965.

Letter No. Kh/RIP/Sagol, dated 14/15-7-65 from the Registrar of Co-operative Societies, Ahmedabad.

RESOLUTION

Under Government Resolution, Industries Department, No. RIP-1065 (Sagol)-62-Kh, dated the 27-4-65 Government has sanctioned a grant of Rs. 34,000 for implementation of the Scheme relating to designing and setting up of an experimental pilot plant for manufacture of improved 'Sagol'. The grant of Rs. 34,000 being inadequate it has become necessary to sanction additional grant for implementation of the said Scheme. Government is, therefore, pleased to sanction and place at the disposal of the Deputy Director of Cottage Industries (Training and Extension), Diamond Jubilee Cottage Industries Institute, Baroda an additional grant of Rs. 1,43,020 (Rupees one lakh fortythree thousand and twenty only) as per details given below for implementation of the Scheme.

	Rs.
1. Machinery	55,000
2. Building	12,200
3. Raw materials	35,000
4. Contingencies	40,820
(a) Technical staff and Labourers	21,000
(b) Electric and Water charges	12,500
(c) Other expenses	7,320
Total	40,820
Grand Total.. .. .	1,43,020

Deputy Director is also authorised to draw and disburse grant, as and when felt necessary.

2. The expenditure on this account is debitable to the head "35-Industries-B-Cottage and Small Scale Industries-B-25 (A) Scheme for intensive development of Small Industries in Rural areas" and should be met from the overall Saving under the head "35-Industries-B-Cottage Industries" by way of re-appropriation during the current financial year.

3. This issues with the concurrence of the Finance Department, dated 27-7-65 on this department file No. RIP-1065 (Sagol) 6775-Kh.

By Order and in the Name of the Governor of Gujarat.,
S. C. SHELAT,
Deputy Secretary to the Government of Gujarat.
Industries, Mines and Power Department.

To,

The Registrar, Co-operative Societies, Ahmedabad.
The District Development Officer, Godhra.
The Assistant Director of Industries, R.I.P., Godhra.
The Deputy Director of Cottage Industries,
(Training and Extension), D.J.C.I., Institute, Baroda.
All Members of the 'Sagol' Advisory Committee, (through the Deputy
Director of Cottage Industries, Baroda).
The Public Works Department.
The Director of Industries, Ahmedabad.
The Personal Assistant to Deputy Minister, (Panchayat).
The Personal Secretary to Minister, (Panchayat).
The Private Secretary to Chief Minister.
The Joint Secretary to the Government of India, Planning Commission, (Rural
Industries Planning Committee), Yojana Bhavan, Parliament Street,
New Delhi.
The Select file.

APPENDIX II

FACULTY OF TECHNOLOGY AND ENGINEERING, BARODA
RESEARCH HOBBY CLUB

Prof. L. B. Shah, President. Polytechnic Premises,
Dr. S. M. Sen, Vice-President. Chhani Road,
Prof. C. H. Khadilkar, Chairman. Baroda-2.
Hon Secretaries--
Shri V. K. Shah, Shri R. V. Phanse
Shri R. R. Parikh, Shri Y. D. Manohar.

MASONRY SAGOL MANUFACTURING UNIT
REPORT

of
The Operational Research
by
The Research Hobby Club,
Faculty of Technology and Engineering,
M. S. University of Baroda
BARODA

November 1964 to 4th October 1965.

Government of Gujarat vide their Resolution No. R.I.P./1064 (Sagol) U.O.-1247-CHH., dated 3rd November 1964 sanctioned the scheme relating to the design and setting up of an experimental pilot plant for manufacture of masonry "Sagol" unit be departmental organisation at Baroda. Government of Gujarat also sanctioned a grant of Rs. 15,000 to the Research Hobby Club of the Faculty of Technology and Engineering, M. S. University to enable the Research Hobby Club to carry out operational Research work and give technical direction to the Officer-in-charge of the execution of the project.

Statement showing Chemical Analysis of the Different Varieties of Limestone

Sr. No.	Locaton of the Limestone.	Chemical analysis.in percentage								Remarks
		(lime) CaO	(Silica) SiO ₂	(Mixed oxydes) R ₂ O ₃	(Iron) Fe ₂ O ₃	(Alumina) Al ₂ O ₃	(Mag-ncsia) MgO	less of Ignition	Other impurity	
1.	Ranoli, Baroda District..	31.13	36.12	5.49	2.55	2.94	1.34	27.02	—	
2.	Godhra, Panchmahals ..	36.47	29.70	2.65	1.15	1.50	0.90	29.80	—	
3.	Kim, Surat District ..	44.38	9.38	7.65	4.83	2.82	0.50	38.06	—	
4.	Dohad, Panchmahals ..	44.70	16.70	1.50	0.40	1.10	1.40	35.70	—	
5.	Rajpipia, Broach District	47.10	5.60	0.60	0.20	0.40	7.00	37.70	2.00	
6.	Chhota Udepur, Baroda District	53.20	4.70	—	—	—	—	42.05	—	
7.	Moti Ratnagar, Near Kapadwanj, Kaira District (Bauxite)	—	2.20	73.10	17.50	54.30	—	24.70	1.30(TiO ₂)	
8.	Tayabra, Near Kapadwanj, Kaira District (Bauxite)	—	2.50	72.60	12.40	53.01	—	24.54	7.19 (TiO ₂)	

The Research Hobby Club accepted the task and applied itself with sustained effort and enthusiasm from 15th November, 1964.

Raw materials.—After making inquiries with the Officers of P. W. D. and Director of Geology of Gujarat State, places round about Baroda, having suitable limestone of quality and in quantity were located and samples were procured. Statement on page 2 gives the chemical analysis of the stones available.

With the basic data available as detailed in the statement procedure was adopted in determining the composition of raw meal for the masonry Sagol by adhering to the following practice in Cement Manufacture. The contents of Iron and Alumina

needs to be high both actually and in proportion to silica. The most favourable relationship is obtained by.

$$\text{Lime standard : } \frac{100 \text{ CaO}}{2.8 \text{ SiO}_2 + 1.1 \text{ Al}_2\text{O}_3 + 0.7 \text{ Fe}_2\text{O}_3} = 95 \text{ to } 100$$

$$\text{Silica Ratio : } \frac{\text{SiO}_2}{\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3} = 1.8 \text{ to } 2.5$$

$$\text{Alumina Ratio : } \frac{\text{Al}_2\text{O}_3}{\text{Fe}_2\text{O}_3} = 1.2 \text{ to } 1.8$$

By studying the above equation we found that we can be sure of best results if the raw meal has following composition :—

CaO	=41 to 42%
SiO ₂	=13 to 14%
Fe ₂ O ₃	=1.8 to 2%
Al ₂ O ₃	=4 to 5%

Other impurities less than 3%

With the above fundamental conception of the composition of the raw meal we prepared different mixtures of limestones from different places as detailed below and manufactured a Masonry Sagol and tested them to ascertain the relative strength and quality of the product.

Sample No.	Lime stone and Bauxite	Percentage in mixture
I	Kim	70.00%
	Godhra	25.00%
	Bauxite	5.00%
II	Kim	50.00%
	Godhra	30.00%
	Chhota Udepur	15.00%
	Bauxite	5.00%
III	Kim	70.00%
	Godhra	20.00%
	Ranoli	5.00%
	Bauxite	5.00%
IV	Dohad	83.50%
	Kim	4.00%
	Godhra	2.50%
	Bauxite	10.00%
V	Dohad	85.00%
	Kim	7.00%
	Bauxite	8.00%

Sampal No.	Lime stone and Bauxite	Percentage in mixture
VI	Ranoli	35.00%
	Kim	10.00%
	Chhota Udapur	50.00%
	Bauxite	5.00%
VII	Kim	30.00%
	Godhra	30.00%
	Ranoli	15.00%
	Chhota Udapur	20.00%
	Bauxite	5.00%
VIII	Kim	30.00%
	Godhra	20.00%
	Ranoli	15.00%
	Chhota-Udepur	30.00%
	Bauxite	5.00%
IX	Kim	40.00%
	Ranoli	20.00%
	Dohad	15.00%
	Chhota Udapur	20.00%
	Bauxite	5.00%
X	Kim	40.00%
	Ranoli	25.00%
	Chhota Udepur	30.00%
	Bauxite	5.00%
XI	Kim	40.00%
	Ranoli	25.00%
	Chhota Udepur	15.00%
	Rajpipla	15.00%
	Bauxite	5.00%

The analysis of the last sample (No. XI) is as under :---

1.	Silica SiO_2	13.65%
2.	Mixed Oxide R_2O_3	7.54%
3.	Magnesium Oxide MgO	1.53%
4.	Iron oxide Fe_2O_3	2.58%
5.	Calcium Oxide CaO	41.862%

This is considered a suitable raw meal and has been recommended.

Pallet making.—Various methods of Pallet making were tried both with a view of ensuring homogeneity of mixture and maintain the form of the pallet, not only during casting stage but also when they are subjected to heat treatment in the Kiln.

The following procedure was followed :---

The lime stones from different localities were crushed in Stone Crushers in sequence charged to a disintegrator to grind it to 30 mesh and stored in different silos. They were mixed in predetermined percentages to have the optimum composition and ground for a period of about $\frac{1}{2}$ hour in a Ball Mill so as to have 100 mesh homogeneous raw meal.

We tried different shapes and sizes of the pallets 1" to 1½" round, round with a hole, square, rectangular etc., carried out extensive exploratory work to define optimum shape to ensure economy of manufacture.

The shape of BADAMI COAL was considered to be the best. A machine to cast such type of pallets was designed and fabricated locally and has a production capacity of about 1 ton an hour. This is one of the special features of the project.

Kiln.—The pallets are required to be subjected to a specified heat treatment. They must be heated to a temperature of 350°C to drive away the moisture, 400°C to 700°C for a period of 2 hours to reduce Fe₂O₃ to FeO, 800°C to 950°C for 4 hours to drive out Co₂ gas, 1100°C to 1200°C to activate the different elements, 1300°C to 1400°C to form clinkers.

To design a Kiln vertical shaft for the above requirement was certainly a difficult task, mainly because this is to be the first of its type in India.

We constructed different laboratory models, fired them to get indicative results. By adopting hit and miss methods for a period of more than 4 months, we were able to evolve a design suitable for the masonry Sagol manufacturing unit. Details of the size and shape of the different component parts, the accessories required to be fitted to the kiln were defined. A working drawing was prepared and passed on to the Officer-in-charge of the execution of the project.

The Unit as designed has been now set up, working trials have been taken during the last month.

The chemical analysis of the masonry Sagol manufactured is found to be as under:—

1. Loss of ignition	..	..	..	..	..	..	—	2.3%
2. SiO ₂	..	..	..	..	..	..	—	22.7%
3. R ₂ O ₃	..	..	..	..	..	..	—	14.2%
4. Fe ₂ O ₃	..	..	..	..	..	..	—	7.1%
5. CaO	..	..	..	..	..	..	—	59.2%
6. MgO	..	..	..	..	..	..	—	1.8%

This indicates that there is about 60 to 80% clinkering in the sample.

Strength tests also indicated that the product has got more than 60% of the strength of standard cement. It sets within reasonable time and has good workability and can be used in the ratio of 1:5 in the mortar for masonry work.

It would therefore be considered as very useful material an intermediate product between lime and cement and can be freely used in the building trade for all the works except R. C. C.

We, the members of the Research Hobby Club feel happy that we could carry out the assignment entrusted to us. Though Rs. 15,000 have been given by the Government to carry out Operational Research, this is far too short than the money actually spent.

The grant is only of 50% of the expenditure incurred. The work would not have been possible, had not the University Authorities allowed the Research Hobby Club to utilise the University Funds, organisation and technical personnel working in the University. I therefore, feel it my duty to record the above facts and express our grateful thanks to the Dean, Faculty of Technology and Engineering, and authorities of the University.

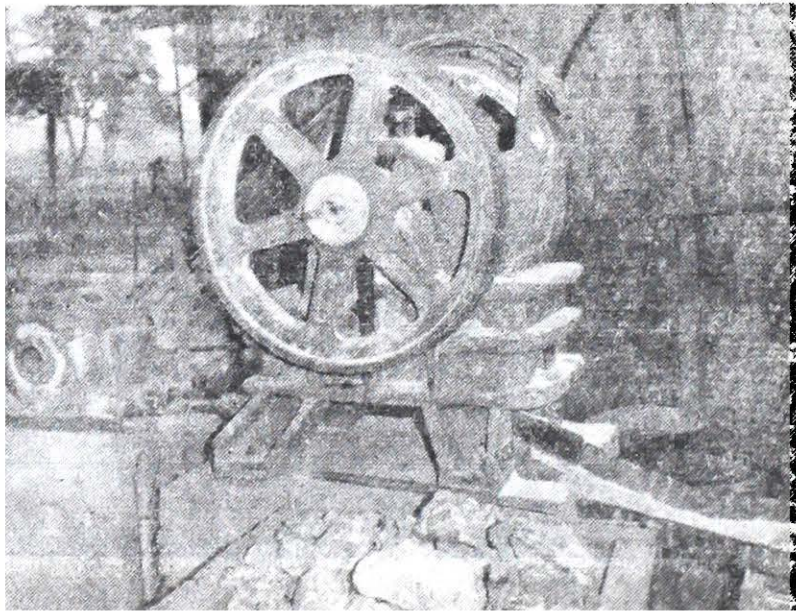
The success of our effort is obviously due to the spontaneous and enthusiastic support and guidance by the Chairman, Dr. C. B. Patel and other members of the Advisory Committee and Shri C. A. Rawal, his associate Shri Pathak, Officers-in-charge of the execution of the project on behalf of the Government of Gujarat.

The Pilot Plant which has been the result of co-operative effort would be appreciated as a pioneering venture to evolve an intermediate useful product in the building trade to meet the shortage of cement in the country and may lead to setting up similar units all over the country.

(C. H. KHADILKAR)
Chairman,
Research Hobby Club.

APPENDIX III

Details of Machinery Purchased for Sagol Pilot Plant for Manufacture of Improved Sagol, Baroda.

Sr. No.	Name and details of machinery.	Nos. purchased.	Name of the firm with address.	Photo/Sketch
1	2	3	4	5
1.	<p><i>Kusum Jaw Crusher JC/94 :</i> Arranged for individual drive complete with motor starter, V-Belt, Rails, Belt Guard, Chute and feeding Hopper.</p> <p>Machine No. 106 Size : JC/94 Type IND with 7.5 H.P. Motor size of mouth 9" x 4" 440 volts V belt drive RPM 1500 capable of crushing 1 to 2 tons per hour of hard stones to 1" size complete with Motor, starter, V-Belt rails, Belt guard, chute and feeding hopper.</p>	1	<p>Kusum Engineering Company Ltd. 25, Swallow Lane Calcutta</p>	

APPENDIX III—(Contd.)

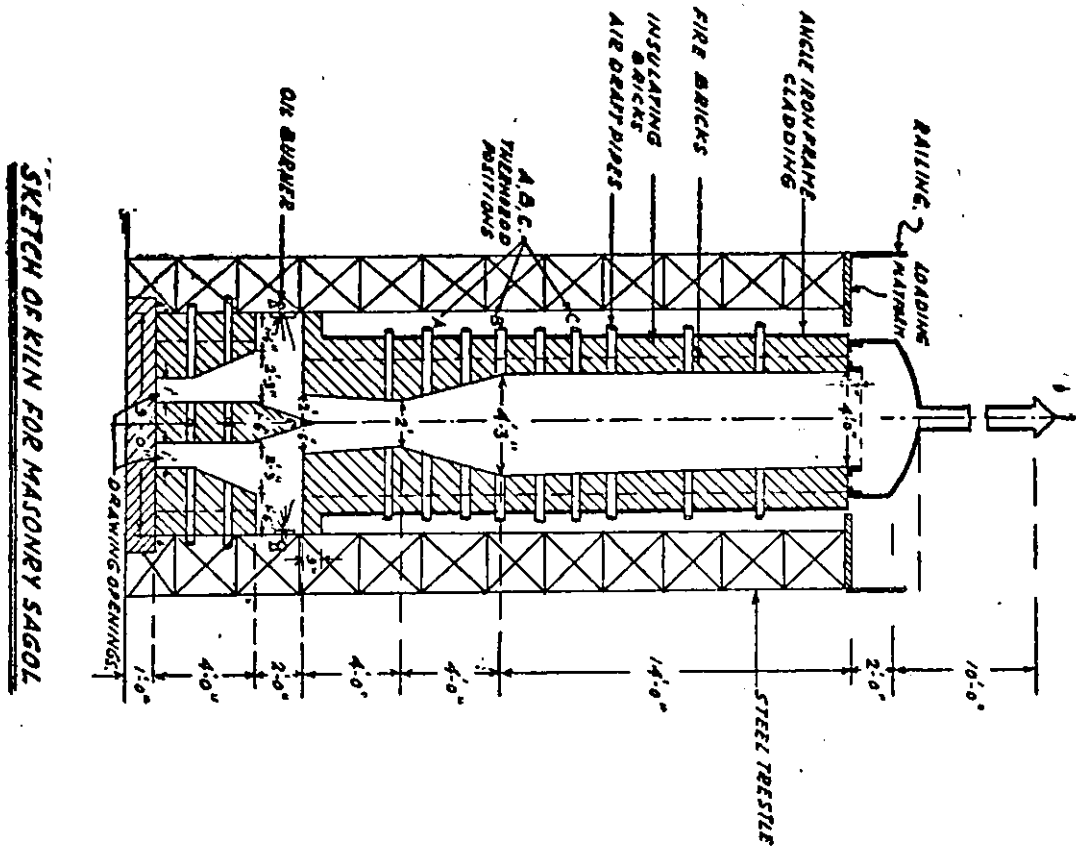
1

2

3

4

5



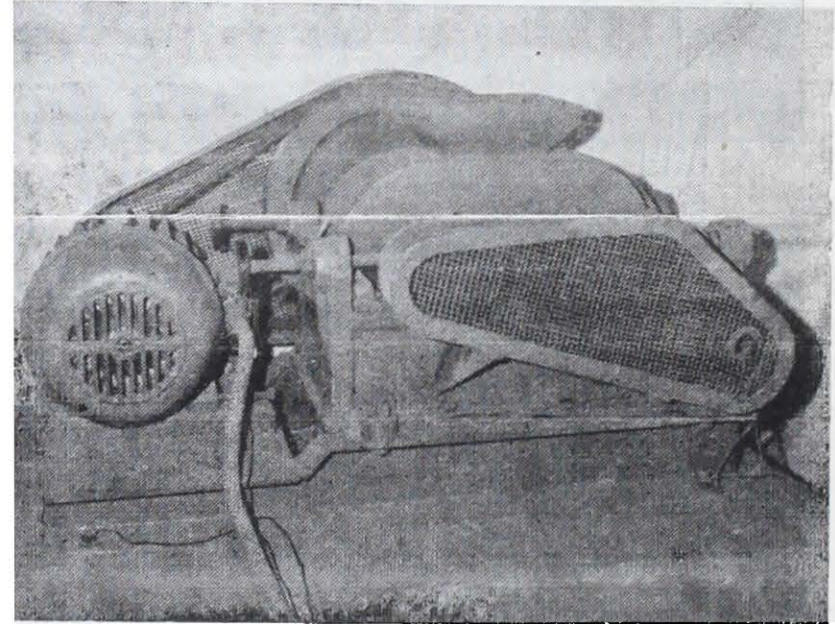
SKETCH OF KILN FOR MASONRY SAGOL

2. **Vibrating Screen Small 20''x40'':** 1 M/s. Sayaji Iron & Engineering Co. (Pvt.) Ltd.
 Chhani Road.
 BARODA.

Screen capacity 3105 tons per hour. Electric drive with 2 H. P. Motor. B.26138. 1425 R.P.M. 440 volts. 50 frequency. 3 V-Belt drive.

3. **'WMI' Double Roll Crusher :** 1 M/s. Western Mechanical Industries Pvt. Ltd.
 "Industry Manor"
 Opp : Bengal Chemicals,
 Post Box 6588
 BOMBAY-18. W.B.

Size 8'' x 6''. V-Belt Driven Frame : from heavy steel structure.
 Bearings : Phosphor bronze brusted bearings.
 Rolls : Made of Manganese steel H. P. of motor (Induction type) 3 phase. 440 Volts. Speed 960 R.P.M. SQ cage Motor Amp. 4.7.



APPENDIX III—(contd.)

1	2	3	4	5
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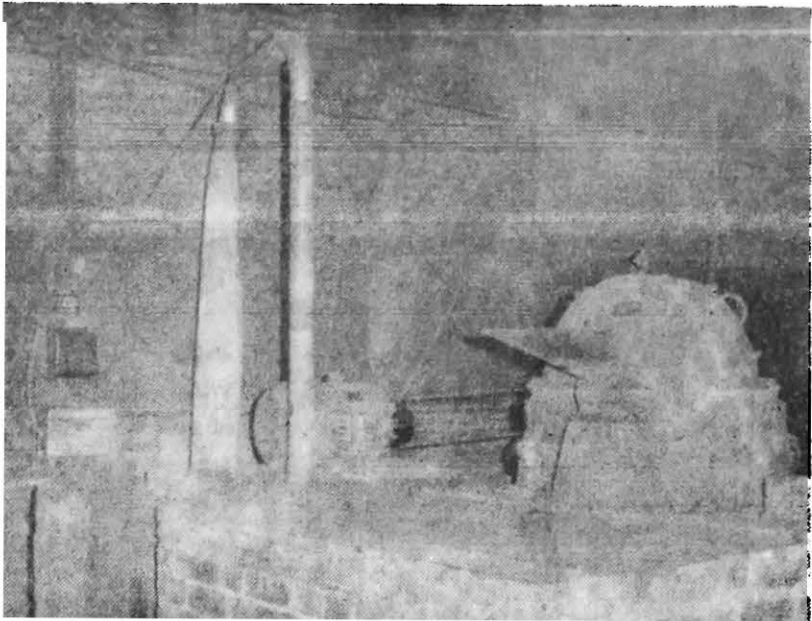
4. Singhasini Disintegrator Size 22" :

fixed hammer type with suitable linings and heavy duty ball bearings with cast iron body.

Disintegrators size 26" capacity of 1 ton per hour

Induction Motor (Jyoit Ltd.)
KW/11 15 HPR.P.M. 1440 PHB
Volts 415 Delta Amps 20.8
Rating CMR Frame CTF 180
Class A.

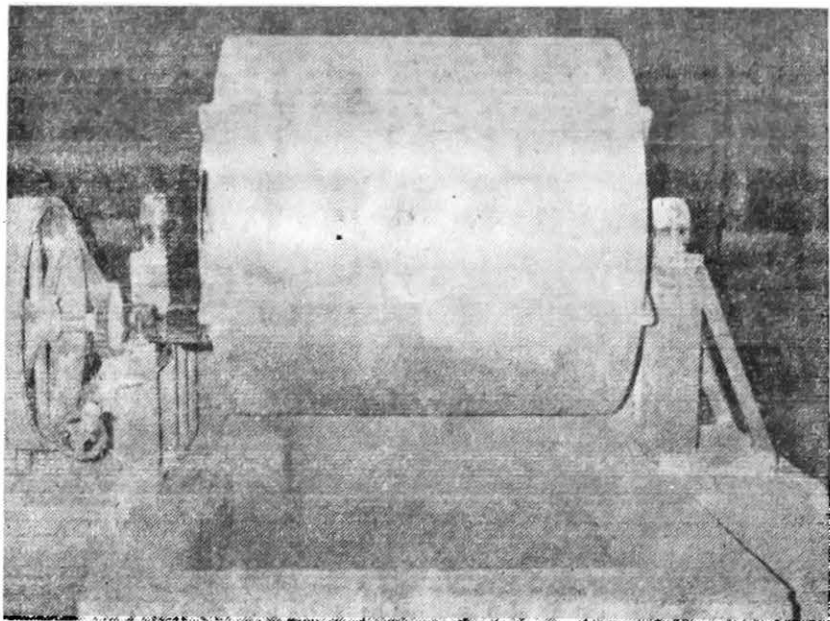
- 1 M/s. Singhasini Engineering Works
84/25, Factory Area,
KANPUR-5.
- 2 Shri G. B. Navangall
C/o. Minerals Machinery Corporation
Baroda Crystal Glass Works Ltd., Pratap Nagar,
BARODA-4.



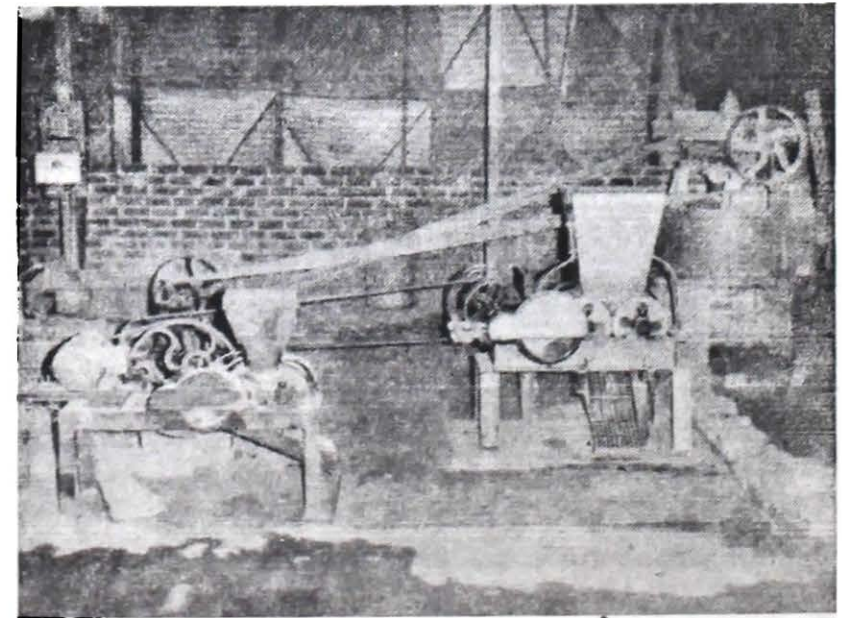
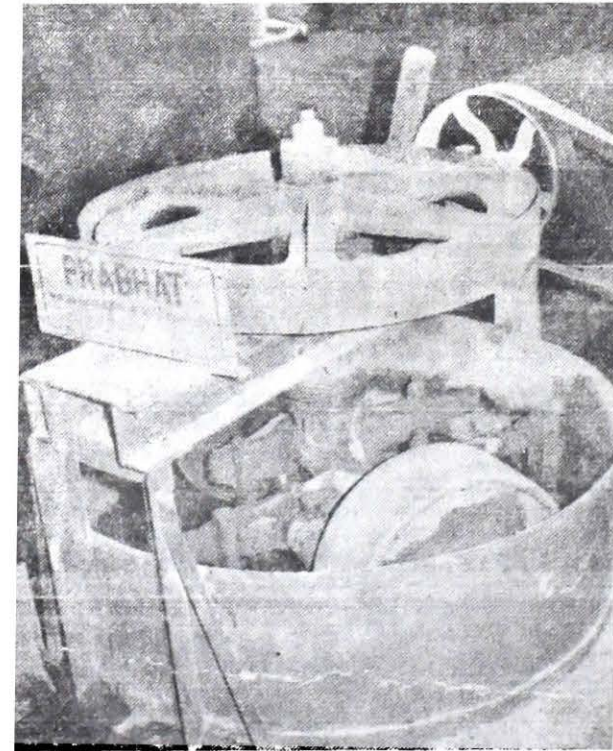
5. Ball Mill :

Size 5' x 5' complete with stand, pully, manhole air tight door, rubber gasket discharge valve with strainer. KW 22/30 HP RPM 970 3 phase Volts 415. Class A.

- 1 M/s. Frigmarics Engineer
Bharat House 104, Apollo Street Fort,
BOMBAY-1.



- 30 mm Balls 2 Tons. M/s. Frigmaires Engineer
Bharat House 104, Apollo
Street, Fort
BOMBAY-1.
6. $\frac{1}{2}$ " Dia. 'Prabhat' Roller Pan : 1 M/s. Sayaji Iron & Engineering
Co. (Pvt.) Ltd.,
Chhani Road,
BARODA.
Mixer without wheels and axles
and without channels cabinet
and Power Unit.
7. Badami Tablet Making Machine : 1 M/s. Bansi Iron Works
Pratapnagar Road,
Goya Gate,
BARODA.
Heavy Type 11" dia. KW 7.5/HP10
960 RPM 3 Phase Volts 415
Delta Amp. 5.1 Rating CMR
Frame LTI



APPENDIX III—(contd.)

1

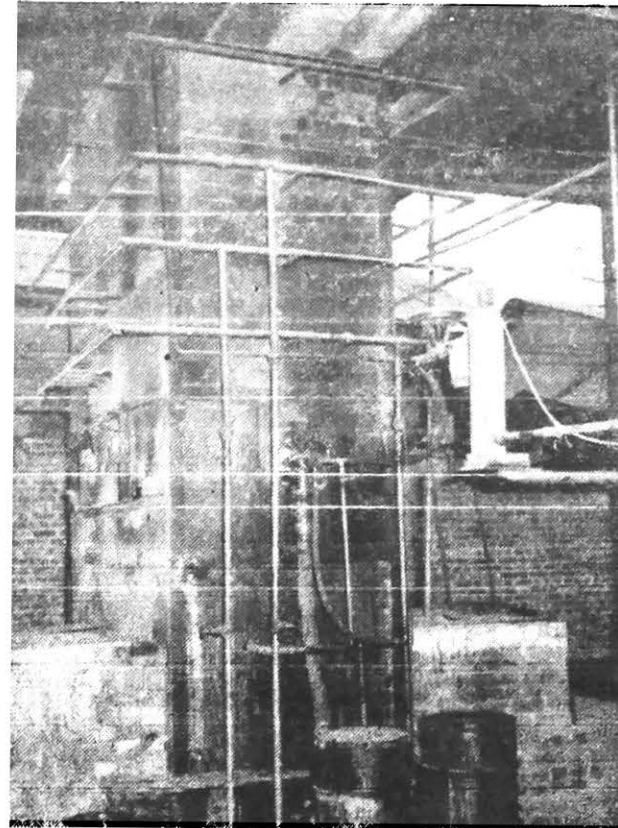
2

3

4

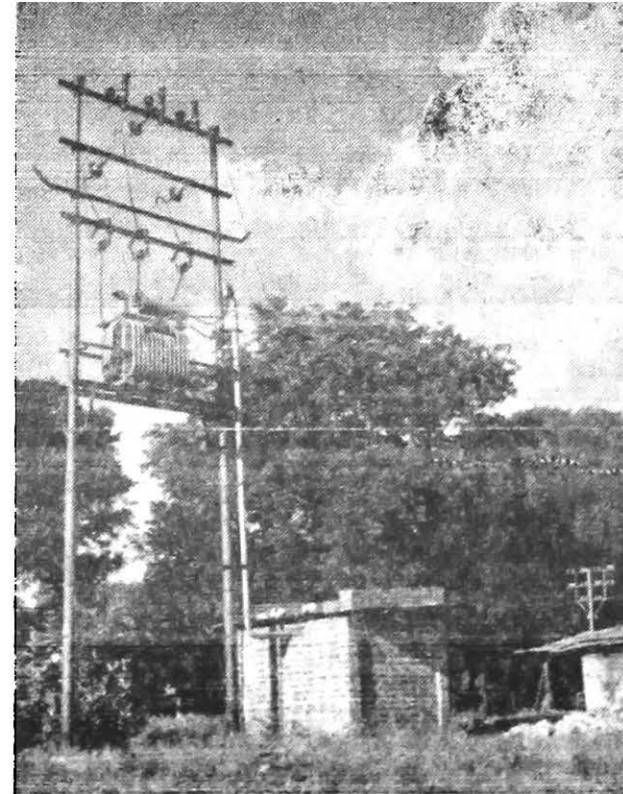
5

8. *Two kilns of about 17' high.* Each kiln has been equipped with two furnace oil burners and four draw in openings. The kiln is constructed with high alumina bricks to withstand the temperature of about 1600°C, tied up with steel angle frames with welded flats and sheets. The kiln is provided with a loading platform and a chimney of about 10' to ensure the necessary draft for burning the coal. The kiln will have a capacity of 2½ tons of clinker a day. The details of the kiln constructed are illustrated in sketch and the photograph.



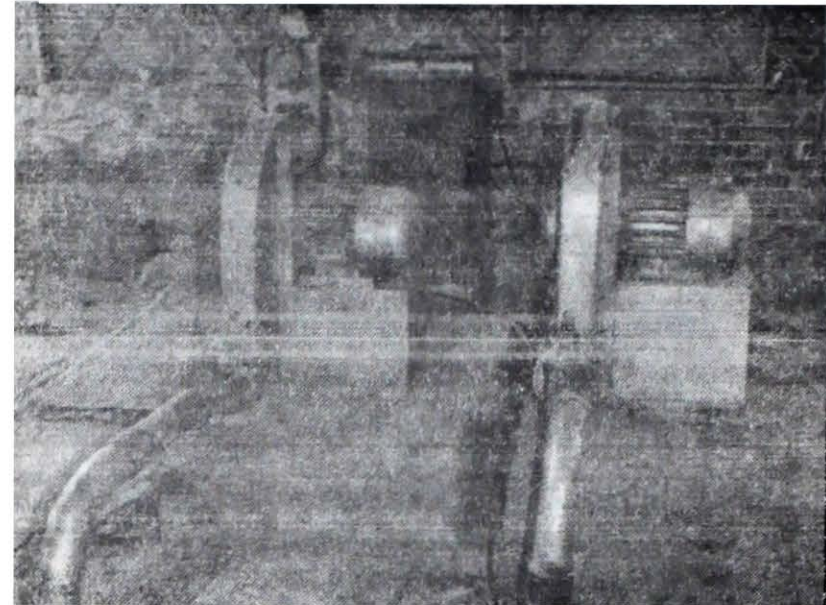
**8-A Oil Burning Equipments, Air
Blowers Tank etc. For kiln:**

- | | | |
|--|---|---|
| (a) Indotherm oil burners model
Valve and size 1. | 6 | M/s. Westerwork Engineers
Private Ltd.
15, Bhandup Village Road
Bhandup
Bombay-78 N. B. |
| (b) Indotherm Refractory bur-
ner blocks suitable for size 1
burner. | 6 | do |
| (c) Indotherm Burner Plates
suitable for size 1 burner. | | do |
| (d) Indotherm electric oil
preheaters of 1.5 KW rating
capacity. | 3 | do |



APPENDIX III (contd.)

1	2	3	4	5
(e) Indotherm Oil Filters	3	M/s. Westerwork Engineers Private Ltd. Bhandup Village Road Bhandup Bombay-78 N.B.		
(f) Metallic flexible pipe 1/2" diameter 1 meter long complete with connections.	12		do	
(g) Indotherm Safety Valves	2		do	
(h) Indotherm Motorised Air Blowers model Tornado 7.5 HP totally enclosed fan cooled, Squirrel Cage induction motor conforming to ISI specifications- for operation on 400/440 volts, 3 phase, 50 cycles, A.C. Supply, 2900 R.P.M. Air Delivery approximately 900 cu. ft/min at 24" WG at blowers outlet.	2		do'	



(i) Starters 15 amps, range 2 M/s. Westerwork Engineers
9 to 14. Private Ltd.
15, Bhandup Village Road
Bhandup, Bombay-78 N.B.

(j) Oil Service Tank (Cubical) 1 do
capacity 360 gallons with one
standard manhole with cover,
one air vent nozzle, one outlet
pipe with plug, one drain pipe
with plug, two lifting hooks and
one gauge glass oil level indica-
tor.

(k) Wasp R. S. S. Semi Rotary 1 do
Double Acting Pump size with
vertical lugs, oval flanges, high
grade cast iron body, gun metal
valve and seats capacity 7 I.M.
P.G.P.M. at 100 strokes per
minute.



APPENDIX III—(contd.)

1	2	3	4	5
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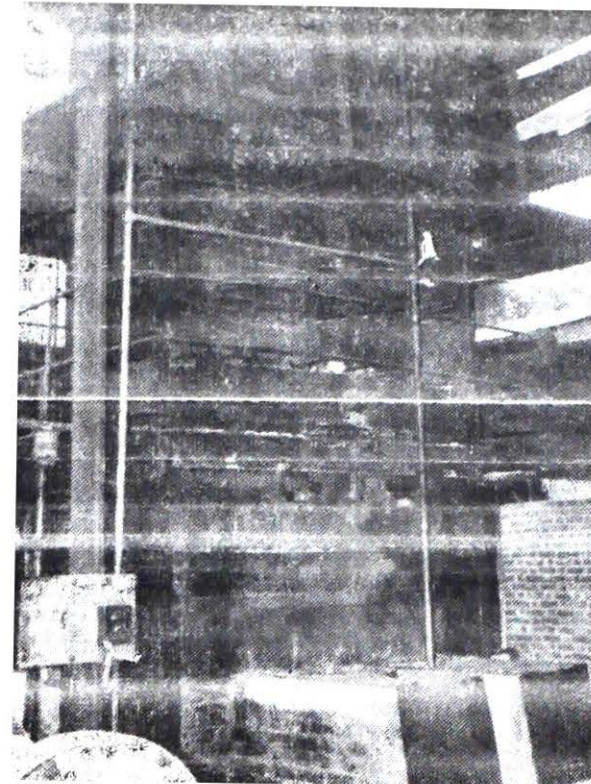
8-B. Pyrometer and Temperature Indicator

Indicating type Pyrometer Range 0/1200°C 684 G.R. Complete with wall bracket.	1	M/s. Gyro Laboratories Private Ltd. 8, Gazdar Street Thakurdwar Bombay-2
--	---	--

Thermocouples, Chromal allumal suitable to use upto C° to 1200°C—40''	4	do
---	---	----

Compensating Cable insulated	36' long	do
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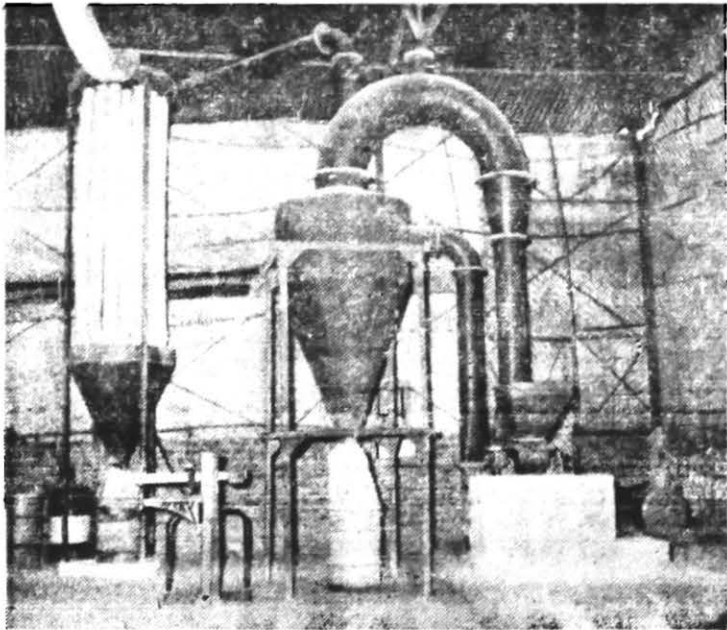
Six way switch	1	do
----------------	---	----



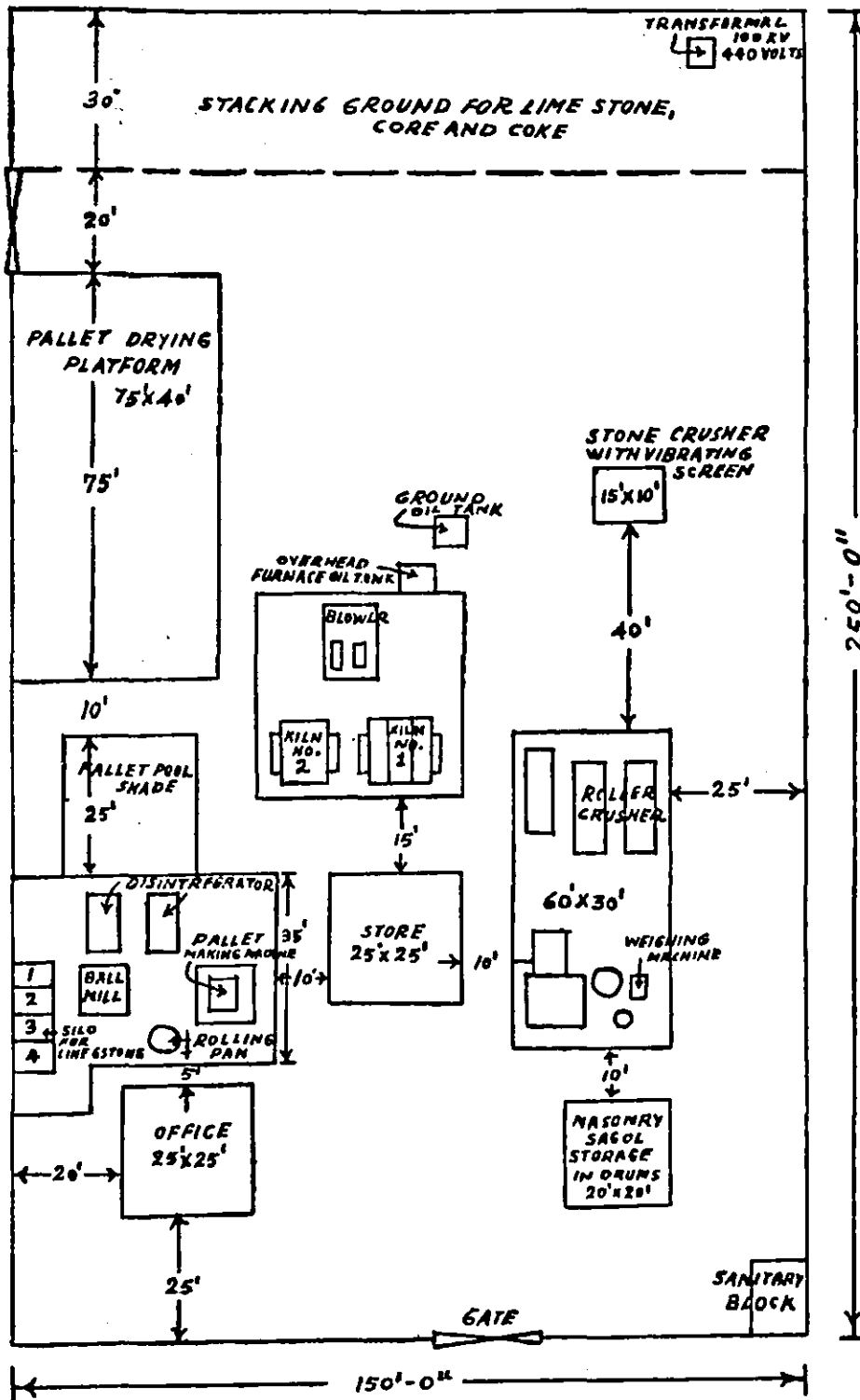
"Toshniwal" temperature indicator Cat. No. IT 61.01 Range 20-1600°C 1 M/s. Toshniwal Industries Pvt. Ltd. Industrial Estate, Makhapura, AJMER.

"Toshniwal" Thermocouple Cat. No. IT 47.05 with Pt Rh 10% Rh element. 4 -do-

Compensating lead Cat. No. IT 97.03A. 40 meters -do-

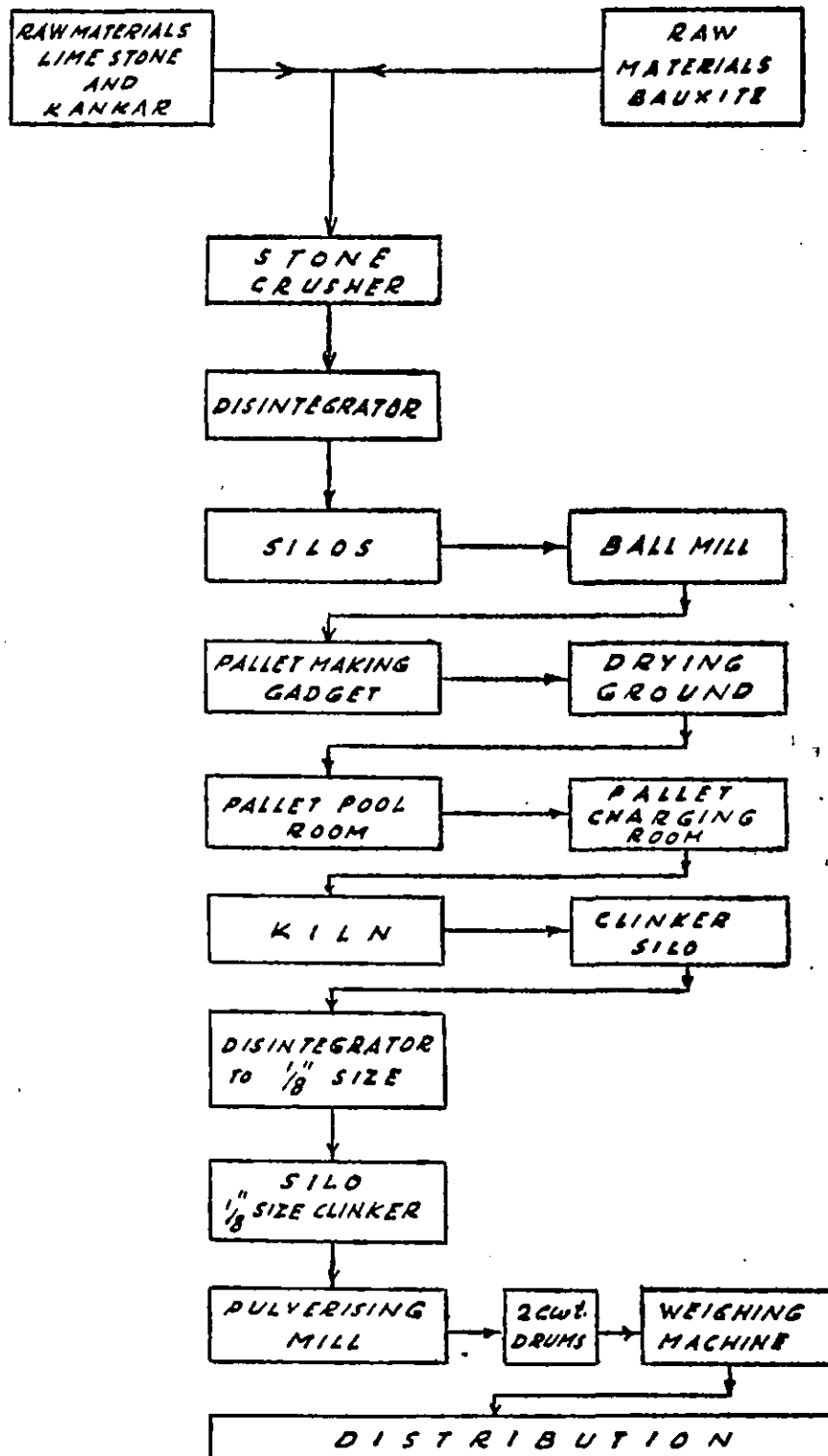
1	2	3	4	5
9	<p>D.P. Impact 25" Pulveriser :</p> <p>manufactured indigenously to standard specification and design. The pulveriser consist of a feed hopper with automatic Feed Spowl worked by a gear drive from the Main Shaft. the Grinding Chamber inlaid with Pached Break plates of special chilled iron set of forged steel hammers fixed to the motor mounted on m.s. shaft; Adjustable whizzer classified for manipulateding the mesh from 60-200 fineness. Air blower top and bottom have of the Tubular Dust Collector and necessary length of M.S. sheet. Tubing from the Fan to the Cyclone and back to the Grinding Chamber : complete with Standard V-belt pulley, capacity from 6-8 tons tons per day depending on the hardness and size of the mineral ground.</p> <p>KW 22/HP 30RPM 1460 volts 415 Delta Amps.420, CTF 200/ Class A. V-Belt drive 5 Nos.</p>	1	<p>M/s. D. P. Pulveriser Works 12, Rake House Lane off Forbes Street, Fort, BOMBAY-1.</p>	
10.	<p>Avery No. 3205/ARA .Portable Platform Scale :</p> <p>Capacity 500 Kg. Platform : 610 x 610 mm. Machine No. C/644736.</p>	1	<p>M/s. Avery Company of India Private Limited, Cama Chambers, Khanpur, AHMEDABAD.</p>	

APPENDIX-IV
 MASONRY SAGOL MANUFACTURING
 PILOT UNIT
 LAY-OUT PLAN
 SCALE :-1"=30'



APPENDIX V

FLOW DIAGRAM
OF MANUFACTURING PROCESS
OF MASONRY SAGOL



APPENDIX--VI

*A Model Scheme for manufacturing 'Masonry Construction Sagol'.
A unit of production capacity of 10 tons per days*

Basis : 300 working days in a year. Annual production 3000 tons.

Process : Dry process based on intermediate technology as developed and tried at the Government Pilot Project Plant, manufacturing 'Masonry Sagol' at Baroda.

	Rs.
I. Non-recurring expenditure (capital investment)	5,00,000
(a) Civil Engineering works :	
On 5 acres of land with sheds and other structure including water supply arrangement as indicated in the lay out plan (Appendix VI C)	Rs. 1,00,000
(b) Machinery tools and equipments.	
(i) As shown in Appendix VI B	2,00,000
(ii) 4 Kilns of special design	
Each kiln to be further equipped with two furnace oil burners with all its accessories viz. blowers, piping, loading platform, chimney, oil tanks, pyrometers, etc. having a clinkering capacity of 2½ tons per day.	1,00,000
(c) Working capital (4 months provision for the equivalent production of 1000 tons)	1,00,000 <u>5,00,000</u>
II. Recurring expenditure (on annual basis)	
Running expenditure	Rs. 3,00,000
(a) (1) Salaries	25,000
(2) Wages to labourers	40,000
(b) Fuel (furnace oil, coal, coke & charcoal etc) ..	66,000
(C) Raw materials:	
(i) Limsetone, 6000 tons at Rs. 15 per ton	90,000
(ii) Gypsum, bauxite, etc.	4,000
(d) Electric and water charges	30,000
(e) Packing charges	25,000
(f) Repairs and maintenance	10,000
(g) Miscellaneous and unforeseen charges	10,000 <u>3,00,000</u>
III. Estimated Income	4,20,000
Sale of 60,000 bags of Masonry Sagol each weighting 50 Kgms. at Rs. 7 per bag.	4,20,000
IV. Gross Profit (4,20,000 - 3,00,000=1,20,000)	1,20,000

V. Provision for interest, depreciation etc.			Rs. 80,000
		Rs.	
(a) Interest at 9% on investment of Rs. 5 lacs . . . . .	..	45,000	
(b) Depreciation of machinery at 10% . . . . .	..	30,000	
(c) Depreciation of building at 5% . . . . .	..	5,000	
		<u>80,000</u>	
VI. Net profit IV—V . . . . .	..		40,000 per year

It will be seen that the manufacturing unit after making necessary provision for interest depreciation etc. is likely to have a net profit of Rs. 40,000 per year which can be ploughed back to the industry to reduce the loan liability.

APPENDIX VI—A

A statement showing the details of personnel required for a factory producing 10 tons of masonry construction 'Sagol' per day.

Sr. No.	Designation of post	No. of post
1.	Manager/Engineer	1
2.	Chemist	1
3.	Foreman incharge of each shift	3
4.	Accountant	1
5.	Store keeper	1
6.	Clerk cum typists	2
7.	Supervisor for Pallet making, pulverising and Ball Mill Section ..	3
8.	Burner operators	3
9.	Day and night watchman	2
10.	Peon and helpers	2
11.	Unskilled workers and labourers in the grinding, pulveriser and kiln Section on daily wages.	50
12.	Maintenance staff: Fitter, Electrician Masson	3

The total annual expenditure of salary and wages bills is estimated at Rs. 65,000 i.e. per month Rs 5,416.

APPENDIX VI—B

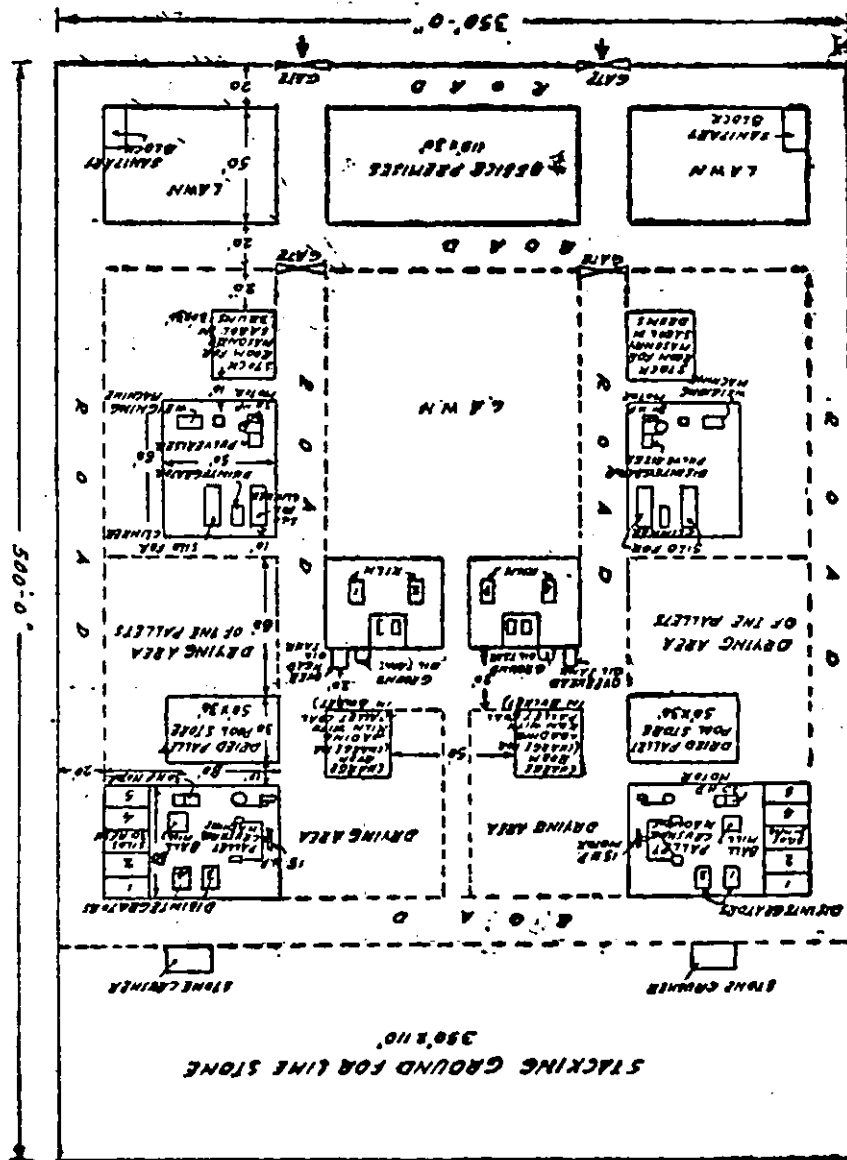
List of machinery equipments etc. required for 10 tons of plant.

Sr. No.	Name of Machines	Nos. required
1.	Stone crusher	1
2.	Roller crusher.. .. .	1
3.	Disintegrator	6
4.	Ball Mill	2
5.	Roller pan Mixer	2
6.	Badami Tablet Making Machines	4
7.	Impact 25" pulveriser	2
8.	Portable weighing machines	2
9.	Ordinary weighing scales with weights.	2
10.	Packing drums of 100 Kg. capacity for filling masonry Sagol	1000
11.	Electric power, Transformer of 200 KVA, supply connection-charges erection of machineries, installation charges and other trial expenses.	

For all the above requirements provision of Rs. 2 lacs has been made.

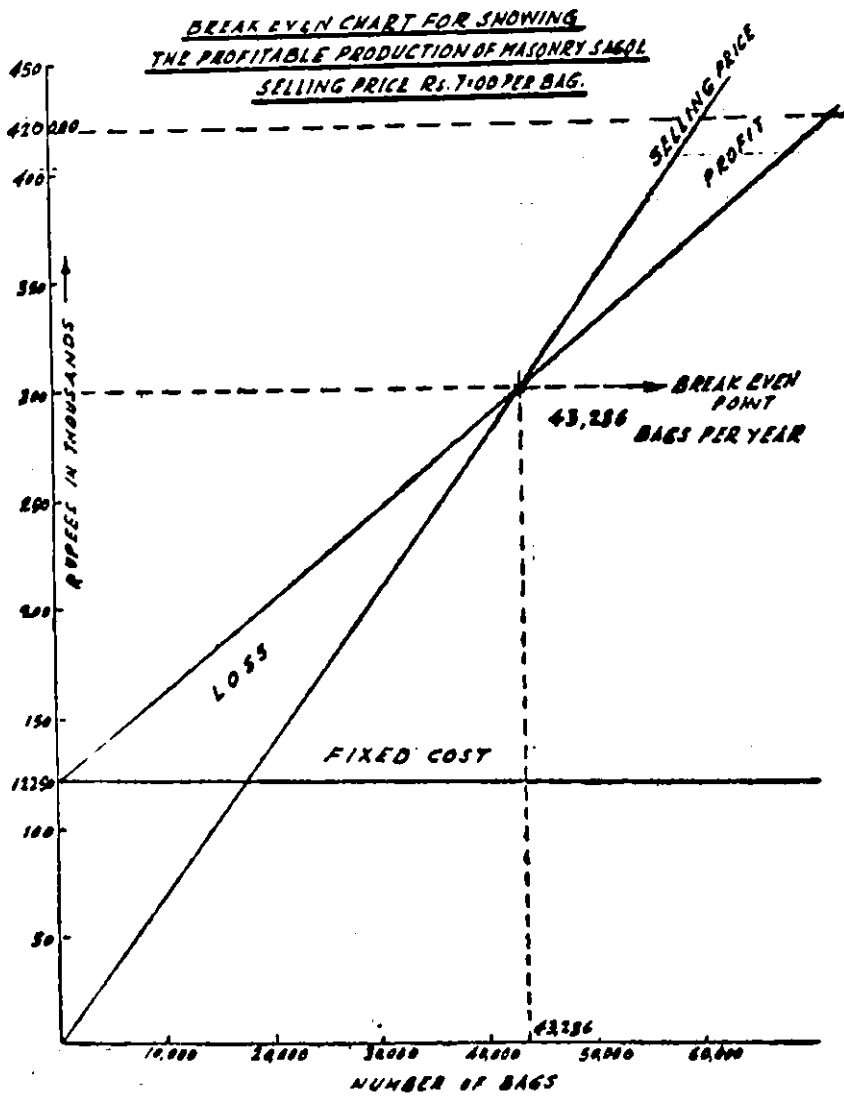
APPENDIX VI-C

MASONRY SAGEH Manufacturing Unit
Production Capacity = 10 tons a day



SCALE : - 9' = 1"

APPENDIX VI-D



A Note on Limestone Deposits of Gujarat State as compiled by the Director of Geology and mining, Gujarat State.

1. General :

Limestone is a carbonate of calcium with an ideal composition of 56% calcium oxide 44% carbon-dioxide, But, in nature, impurities such as magnesium carbonate, silica, alumina and iron-oxides, in various proportions, are generally present. And on the basis of these impurities, the limestones are classified into those of different grades, as chemical grade, flux grade etc.

When the proportion of magnesium carbonate goes on increasing, say to more than 10% the material is called magnesian limestone or dolomite, The latter is a double carbonate of calcium and magnesium, wherein, theoretically, calcium carbonate is 54.35% and magnesium carbonate 43.55%. Dolomite too, has the same impurities mentioned above.

The limestones are of sedimentary origin. But during the process of metamorphism, they undergo a physical change and are recrystallised. This variety is known as a crystalline limestone or marble.

2. In the State of Gujarat, the limestones of sedimentary as well as metamorphic origin are found to occur in various areas in Saurashtra and Kutch and Baroda, Banaskantha, Sabarkantha, Surat, Panchmahals districts of Gujarat Region. The deposits, in all these places are rich and this note summarises the information available on them.

Description of the deposits

(a) *Bhavnagar district :*

Miliolitic Limestone.—It is a formation of recent origin consisting mostly of shells of foraminifers that have been consolidated into a kind of coarsely bedded, white or cream coloured limestone. Hence this is an almost pure variety of fossiliferous limestone

This limestone is found to occur in Saurashtra over extensive areas along the southern coastal tract and also as a number of isolated patches on hill slopes and fringing the Gir plateau for considerable distances inland.

Distribution.— Miliolite limestone in the Talaja taluks of the district was investigated by the Directorate of Geology and Mining, Government of Gujarat. The limestone is found to occur in the coastal area of the district. An area of about 12 sq. kms. between North of Gopnath and South-west of Methla was surveyed and found of bear limestone. The measurable thickness of the limestone band varies from 9.3 meters to 18.25 meters, but the beds are usually much thicker.

Analysis of limestone.—A total of 30 samples was analysed. The limestone is found to have the following range of composition.

CaO	41.5 to 51.2%
MgO	0.7 to 3%
SiO ₂	5.1 to 15.1%
R ₂ O ₃	2.1 to 5.7%
Fe ₂ O ₃	1.5 to 3.1%

Reserves.—The total probable reserves of limestone in the area between Gopnath and Methla are estimated at 256.70 million tonnes. In addition to above, a huge quantity of calcareous sand is found to cover the limestone. Though it is high silica-content it is low in magnesium content, and hence may be used after blending. Probable reserves are estimated at 35 million tonnes.

(ii) *Mahuva and other areas.*—Limestone of similar nature is also reported from Mahuva, Piperla, Sonosara, Chogat, Naip etc. and in Zanzmer areas.

There is no difference in the quality of limestone available in these areas as these deposits form the continuation of the deposits described above.

These deposits of limestone and sand are about 40 miles from Bhavnagar and are connected by a narrow gauge railway line.

Bhavnagar district : (Summary)

<i>Details of the area</i>	<i>Reserves</i>
Area between North of Gopnath and South-west of Methla	Limestone 256.7 million tonnes.
do	Calcareous 35 million tonnes Sand.
Mahuva, piperla, Sonasara, Chogat, Naip etc.	Reserves of deposits not known, these are now being investigated.

(b) *Amreli district*.—Miliolite limestone is also available in Amreli district in the portion bordering the sea in a strip of land about 15 miles in width. The occurrences of limestone at a few localities have been described below :

(1) *Areas around port Victor*.—There are a number of places around port Victor where limestone is found to occur. They are

- (1) Chanch Island
- (2) Visalia
- (3) Danterdi
- (4) Bhakodar etc.

A short description of the above areas is as follows

(ii) *Church Island* (5 miles from port Victor)

Here the limestone occurs over the entire island with a length of about 4 miles and width of about 2 furlongs. The limestone forming the cliffs is buff coloured, sandy and current bedded and occurs as horizontal or gently inclined layers. But most of the limestone is found to be hard and massive. The samples have analysed 65.86% CaCO_3 , other impurities being silica, iron and aluminium oxides.

The reserves in the area are not calculated, the grade also appears to be poor.

Visalia (5 miles East of port Victor).—Miliolite limestone occurs in the area stretching to the south and west of this place. Shallow pits in the marshy region indicate the presence of cream or brown coloured, thin bedded porous limestone. The limestone may also occur below the saline marsh over extensive areas. A sample analysed 89.62% CaCO_3 .

Danterdi.—A limestone occurrence of a similar type was also noted in this place. It is mostly under cultivated lands. The deposits here and at Visalia are not considered economically important.

(iii) *Bhakodar*.—Limestone found here is of a considerable thickness and the wells in this region are found to penetrate this formation only. The limestone is massive and thick-bedded at the surface and is thin bedded, friable below. A sample analysed 90.45% CaCO_3 . This area seems to be having fairly huge deposits of limestone of a good quality.

In an area about 11 miles southwest of Port Victor, falling in the village Varashrup a fairly good deposit of limestone is available. The limestone, on analysis, was found to be having the following composition :

	(1)	(2)
CaO	43.63%	46.20%
MgO	0.86%	1.26%
SiO ₂	14.20%	11.06%
Fe ₂ O ₃	2.07%	1.07%
Al ₂ O ₃	2.93%	2.70%
Loss on ignition	35.46%	35.90%

Reserves.—It is estimated that the area in varashrup and Vand holds deposits of about 16 million tons of limestone suitable for cement production.

It is also estimated that the deposits of Bhakodar, Varshrupvand and Babarkot-Mitiala, that is the deposits to the east of Jafrabad, will yield about 43 million tons of limestone. The details are as under :

Areas around Jafrabad (East).—These are by far the best areas in Amreli district as far as the occurrence of limestone is concerned. The areas having limestone deposits are as under :

- (1) Babarkot
- (2) Mitiala
- (3) Songadh

These areas fall on the eastern side of Jafrabad and bear extensive deposits of limestone and wind-blown calcareous sand dunes. This area spreads over about 5 square miles between Babarkot and Mitiala. The limestone dips at angles of 20-30°. Generally the top 1 to 6' consist of buff-coloured, hard, compact limestone descending into a softer variety. A layer of about 50-100' of calcareous sand covers the limestone in the areas.

A uniform thickness of 60' of limestone can be seen in many well sections spread over 1½ square miles.

In Babarkot area limestone forms 80' high cliffs, in places, overlooking the sea.

The representative samples of limestone from Babarkot-Mitiala area are analysed as under :—

	(1)	(2)
CaO	51.15%	49.62%
MgO	0.51%	0.86%
SiO ₂	4.48%	7.52%
Fe ₂ O ₃	1.94%	1.14%
Al ₂ O ₃	0.66%	1.06%
Loss on ignition	40.72%	38.60%

Reserves.—It is estimated that the area around Babarkot-Mitiala will yield about 27 million tons of limestone upto a depth of 5' only.

Areas around Jafrabad (West).—A buff coloured miliolite limestone with a regional dip of 12-32° due North-East and duness of calcareous sand, cover an area of about 3½ square miles around Jafrabad with Arabian sea to the south, marshy land to the north and east and south east of Jafrabad creel.

The quarry cutting showed a thickness of 15-25' of limestone of the same nature described above.

Analysis of the samples of limestone from these areas indicated that they contain

	(1)	(2)
CaO	42.04%	51.76%
MgO	1.96%	0.62%
SiO ₂	13.88%	3.02%
Fe ₂ O ₃	3.88%	0.81%
Al ₂ O ₃	3.32%	1.49%
Loss on ignition	33.68%	41.84%

Reserve.—About 16 million tons of this material will be available for exploitation within a depth of 5' from the surface.

There is another deposit of 5½ million tons of Limestone and another 5½ million tons of calcareous sand spread over an area of 1½ square miles.

Amreli District (Summary)

<i>Details of the area</i>		<i>Reserves</i>
1.	Chanch Island-Visalia-Danterdi Limestone	Reserves not known
2.	Bhakodar Limestone	Huge deposits, Reserves not known
3.	Varshrup-Vand Limestone	16 million tons,
4.	Areas around Jafrabad (East) Limestone	27 million tons 5' depth only.
5.	Areas around Jafrabad (West) Limestone	2½ million tons upto 5'
		Calcareous 5½ million tons sand

(c) *Junagadh District.*—Miliolite limestone is found to occur all along the southern side in a coastal strip, from Una, Kodinar through Mangrol to Miani, north-west of Porbandar.

Details of limestone deposits around some of the localities are as under :

(a) *Una.*—There are many outcrops of limestone around Una where several quarries are working. The thickness of the limestone bed is about 3'. The limestone contains 83% of CaCO₃, on an average.

The limestone, here, is underlain directly by the Deccan trap or is separated by a conglomerate.

(b) *Veraval.*—The limestone deposits described here, extend from Prachi 17 miles east of Veraval to Mangrol 20 miles west of Veraval.

The limestone occurs as horizontal layers at the surface on low ground without distinct stratification, is compact and massive but is not continuous or uniformly distributed.

Analysis of limestone.—A sample of limestone from Prachi has been analysed with the following result :

CaO	..	..	..	..	..	53.86%
MgO	..	..	..	..	..	0.65%
SiO ₂	..	..	..	..	..	1.12%
Al ₂ O ₃	..	..	..	..	..	—
Fe ₂ O ₃	..	..	..	..	..	0.52%

Reserves.—About 300,000 tons can be produced from Veraval-Gorakmandi-Prachi area within a depth of 5' from the surface.

(c) *Chorwad to Mangrol*.—For a distance of about 10 miles, most of the area showed the presence of a good quality limestone, 1 to 4' thick. At certain places, there are little hillocks of limestone where the thickness may increase to 15'.

(d) *Mangrol to Porbandar*.—North-west of Mangrol there are several quarries on the road, leading to Porbandar. The thickness of the limestone appears to be 5'. Analysis showed the presence of 89.06% CaCO₃.

(e) *Porbandar-Adityana*.—By far the most important deposits of limestone are found to occur around Porbandar in Gora, and Adityana. The quarries at Adityana are the largest and best known in the district which are situated on a ridge about 296' above sea level, along north-west-south-east between Adityana and Barda hills. The stone is white, cream or buff coloured and fine-grained. The thickness of limestone overlying the Deccan traps varies from 5' to 100'.

The limestone formation can be stated to extend from Ranpur in a southerly direction to Adityana and east beyond Ranavav for about 15 miles. It is also reported to occur towards east in Kutiyana.

The limestone is of high purity having more than 90% of CaCO₃. Most of the areas are leased out to consumers like cement and chemical industries.

Analysis—

CaO	..	..	..	..	51.76%
MgO	..	..	..	..	0.63%
SiO ₂	..	..	..	..	3.97%
Al ₂ O ₃	..	..	..	..	1.77%
Fe ₂ O ₃	..	..	..	..	0.65%
Loss on ignition	..	..	..	..	41.09%

A survey of limestone was done by the Department of Geology and Mining, over an area of 5.66 sq. kms. near Porbandar in village Dharampur. It resulted in proving of 9.80 million tonnes of limestone.

Junagadh District (Summary)

<i>Details of the Area.</i>				<i>Reserves.</i>
1.	Areas around Una-Kodinar	..	..	Limestone Reserves not known.
2.	Veraval-Gorakhmandi-Prachi	..	..	Limestone 300,000 tons upto a depth of 5'
3.	Chorwad-Mangrol	..	..	Limestone Reserve not known.
4.	Village Dharampur (near Porbandar)	..	..	Limestone 9.80 million tonnes.

(d) *Jamnagar District*.—In this district limestone of the Gaj series (Dwarka beds) is found to occur along the western coast from Okhamandal, to Sikka-narara islands in the north of Jamnagar. Even coral limestone is found at Okhamandal coast.

Distribution.—Coral limestone is found to occur in Okhamandal and extends upto Mithapur. The thickness of the limestone seems to vary between 5-10'.

The analysis of limestone from Mithapur is as follows :

CaCO ₃	..	..	..	..	95.94%
MgO	..	..	..	..	1.5%
SiO ₂	..	..	..	..	2.22%
Fe ₂ O ₃	..	..	..	..	0.60%
Al ₂ O ₃	..	..	..	..	0.12%

Reserves.—Limestone reserves in the areas around Mithapur work out to be 5 million tons.

In the islands of Sikka and Narara the sea sand is calcareous sand contains much as 90% of CaCO_3 .

The limestone at these places is being utilised for the manufacture of cement and chemicals.

There are various deposits of miliolite limestone in other parts of the State. The limestone from Gop is also being used for the manufacture of cement.

The limestone from Dwarka beds is fossiliferous and coarse grained and has resulted from marine coastal accumulations. At places they change to calcareous sandstones and flagstones. The average thickness can be taken to be 20'

Jamnagar District (Summary)

<i>Details of the area.</i>			<i>Reserves.</i>
1.	Area around Okhamandal and Dwarka	Limestone	Reserves not known.
2.	Area around Mithapur		5 million tons.
3.	Area around Gop		Reserves not known.
4.	Narara and Kaila islands near Sikka ..		Reserves not known.

(c) *Kutch District.*—Nummulitic limestone is found to occur over extensive areas in Kutch district. The limestone is chalky white to yellow with white in colour. White in colour. It is also brown and grey in some places. The beds are mostly horizontal. The thickness of the limestone beds various from 2 meters to over 14 meters.

It is a fossiliferous nummulitic limestone containing Nummulities, Corals, Echinoids and Gastopods. It is supposed to be of Kirthar to lower Nari in age.

Distribution.—The Directorate of Geology & Mining carried out prospecting work initially in village Ramania and adjoining places covering about 13 sq. kilometers of the area. This work was done in the first half of 1964.

Analysis.—About 30 samples of limestone were analysed from the area. They indicate the limestone to be of high grade with low impurities such as MgO , SiO_2 , Al_2O_3 etc. Some of the results are as under :—

	(1)	(2)	(3)
CaO	48.3%	49.1%	49.1%
MgO	2.1%	2.7%	1.4%
SiO ₂	4.00%	2.7%	5.5%
R ₂ O ₃	2.5%	2.0%	2.5%
Fe ₂ O ₃	1.0%	1.8%	1.5%
Loss on ignition	43.1%	42.3%	41.5%

Reserves.—The total reserves of limestone over an area of 13sq. kilometers are estimated to be about 124.66 million tonnes

In continuation to the work mentioned above, the Directorate has taken up investigation between October, 1964 to March 1965 over the following villages :

- (1) Waghapadar
- (2) Sansora
- (3) Kharoda
- (4) Khari
- (5) Hasudi
- (6) Kuraini - Fulra

The limestone investigated here is of the same nature as described earlier.

(i) *Villages Kharoda & Khari.*—The nummulitic limestone spreads over an area of 6.4 sq. kms. and extends further around Jadhwa, Kaman and beyond. In this area, limestone is found to attain a maximum thickness for a long distance upto the east of village Guhar.

(ii) *Village Kuraint, Fulra.*—The limestone belt takes a northern turn towards the north east and extends across Kuraini, Fulra, Baiwa and ultimately to Lakh. The thickness varies from place to place, over 60 meters at Waghapadar, over 70 meters at Ghur.

Analysis of limestone from Waghapadar and Fulra are as follows :

Waghapadar :

CaO	..	..	49.56%
MgO	..	..	1.92%
SiO ₂	..	..	1.13%
Al ₂ O ₃	..	..	1.9%
Loss on ignition..		..	43.72%

Fulra :

CaO	..	..	52.31%
MgO	..	..	0.67%
SiO ₂	..	..	1.82%
Al ₂ O ₃	..	..	1.87
Fe ₂ O ₃	..	..	—
Loss on ignition..		..	42.44%

Reserves.—This in an area of 64.33 sq. kilometers, spread over the above mentioned villages, is estimated that about 700 million tons of limestone will be available.

In all, in Kutch district, so far the work done by this Department has proved the existence, of huge deposits of good grade limestone covering an area of 83. sq. kilometers with probable reserves of about 324 million tonnes.

Kutch District (Summary)

<i>Details of the area.</i>		<i>Reserves.</i>	
1.	Area around village Ramania.. ..	Limestone	124.66 million tonnes.
2.	Villages Waghapadar, Sansora, Khari etc. :	Limestone	700 million tonnes.

(f) *Banaskantha and Sabarkantha districts.*—In the North-Eastern part of the state in Banaskantha and Sabarkantha district, crystalline limestone of Ajabgarh series of the Delhi system, occurs over extensive areas as thin bands running parallel to each other in the NE-SW direction with the angle of dip varying between 50-70° due SE. This occurrence is seen from village sandoshi, situated on the western side of the river Sabarmati, in Banaskantha district to Poshina in Sabarkantha district and beyond into Rajasthan. The outcrops seem to converge in the South and broaden towards North. Moreover, it is found to form ridges or low lying hill-chains which are generally not more than 400' above the plane.

The limestone is crystalline, hard and compact with white, grey greyish black and green colours. It also varies in granularity from coarse to fine-grained.

The common impurities associated with these rocks are quartz, veins, mica, tremolite, diopside and other silicate minerals.

The width of the limestone bands in this region varies from 50 meters to as much as 500 meters at different places (one band is found to be more than 500 meters NW of village Hirad).

Crystalline limestone also occurs in two distinct hill ranges viz., Divania range and Karamudi range. The Divania range, made up of three separate ridges, contains a band of high grade limestone in each ridge. The limestone in Karamudi range appears to be of inferior grade but can be used after blending for the manufacture of cement.

Distribution.—Villages-Sandoshi-Janera, Magwas, Birpur, Ranpur, Poshina etc.

The different limestone bands, in and around these villages, are estimated to cover a total area of nearly 10 sq. miles. The limestone can be worked to a depth of 50 feet. By volume, the limestone constitutes about 75% of the total material (balance 25% being phyllites, schists etc.) The probable reserves, on this basis, work out to be 71.1 million tons of limestone. The analytical results of samples from Ranpur & Birpur areas are as follows :

Sample from Ranpur (Average of 50 samples) :

CaO..	..	..	..	..	..	50.8%
MgO..	..	..	..	..	..	1.4%
SiO ₂..	..	..	..	..	..	5.9%
R ₂ O ₃	..	..	..	..	..	1.1%
Loss on ignition	..	..	..	..	..	37.4%

Sample from Birpur (Average of 48 samples) :

CaO..	..	..	..	..	..	46.5%
MgO	..	..	..	..	..	2.3%
SiO ₂..	..	..	..	..	..	10.6%
R ₂ O ₃	..	..	..	..	..	3.2%
Loss on ignition	..	..	..	..	..	37.4%

The estimate of the limestone deposits as above is a result of the survey conducted by Directorate of Geology and Mining.

addition to the above, the limestone is also available in the following places.

(a) *Village Pasual.*—About 24 miles by road from Deesa, on the western side of river ship there is a limestone deposit associated with banded gneisses and granites. It occurs over an area of one mile in length and a quarter mile in width. About 3 to 4 million tons of good quality limestone are estimated to be available from here.

(b) *Analysis of Pasual limestone :*

CaO..	..	..	..	..	..	51.09%
MgO	..	..	..	..	..	1.27%
SiO ₂..	..	..	..	..	..	0.60%
Fe ₂ O ₃	..	..	..	..	..	0.88%
Al ₂ O ₃	..	..	..	..	..	2.62%
Loss on ignition	..	..	..	..	..	42.28%

(c) *Village Diwania.*—This place is situated to the South-east of Shri Amirgadh Railway station. The limestone in this area is of high crystalline variety, striking NE-SW. The area is estimated to contain about 5 million tons of limestone with the following composition :

CaO	..	..	..	..	51.08%
MgO	..	..	..	..	3.29%
SiO ₂	..	..	..	..	1.45%
Fe ₂ O ₃	..	..	..	..	0.40%
Al ₂ O ₃	..	..	..	..	0.50%
Loss on ignition	..	..	..	..	42.64%

(d) *Village Karamudi.*—In this village a big patch of land bearing limestone, about $\frac{1}{2}$ a mile in width occurs in the hilly regions bordering Rajasthan. The limestone is of the same nature described above. In this area over 15 million tons of limestone are expected to be available within a depth of 50 feet from the surface.

Analysis of Karamudi limestone :

CaO	..	..	..	..	37.49%
MgO	..	..	..	..	2.85%
SiO ₂	..	..	..	..	21.56%
Fe ₂ O ₃	..	..	..	..	1.93%
Al ₂ O ₃	..	..	..	..	6.77%
Loss on ignition	..	..	..	..	26.42%

Village Khunia.—In this village a deposit of 0.2 million tons is expected to occur having the following composition :

CaO	..	..	..	..	50.37%
MgO	..	..	..	..	3.02%
SiO ₂	..	..	..	..	6.24%
Fe ₂ O ₃	..	..	..	..	0.51%
Al ₂ O ₃	..	..	..	..	0.89%
Loss on ignition	..	..	..	..	58.94%

Other deposits of crystalline limestone are also reported from the following places in Banaskantha district.

Village	Ganguwada
"	Kotada
"	Bhilachal
"	Nandmatia
"	Bhaldew
"	Ambamata
"	Chikhla
"	Zharibao
"	Kotesar

Village Ganguwada.—The village is situated at a distance of about 20 miles from the nearest Railway station Iqbalgadh. The limestone of crystalline variety, occurs about 2 miles East of Ganguwada village. The analytical results of a sample of limestone are as under :

CaO	..	..	..	..	51.2 %
MgO	..	..	..	..	5.4 %
SiO ₂	..	..	..	..	0.7 %
Fe ₂ O ₃	..	..	..	..	0.1 %
Al ₂ O ₃	..	..	..	..	0.5 %
Less on ignition	..	..	..	..	42.2 %

This deposit has been examined by the Directorate of Geology and Mining and has been leased out to a private party.

Village Ambamata.—The survey carried out by the Directorate of Geology and Mining has also revealed the deposits of limestone near Zharivao, Kotesar, Chikhla and Kumbharia in the hilly areas around Ambata. The deposits are about 20 miles from Shri Amirgadh Railway station. The analytical results of the samples of limestone from these areas are as under :

				Chikhla	Kumbhariya	Zarivao
CaO	..	..	..	52.5%	51.9%	53.00%
MgO	..	..	..	2.8%	3.2%	1.00%
SiO ₂	..	..	..	2.5%	1.3%	3.6%
R ₂ O ₃	..	..	..	0.7%	0.6%	0.3%
Loss on ignition	..	..	..	41.9%	43.2%	42.5%

From the above description of various areas in Sabarkantha and Banaskantha districts, it can be seen that there are huge reserves of crystalline limestone that are generally pure enough to make it suitable for cement industry. Dr. R. C. Roy, Director General Geological Survey of India, in his "Report on limestone deposits in Abu Road Region, Bombay State", October 1953, stats that :

"All samples analysed, excepting that from Maval, are suitable for the manufacture of cement or lime"

The deposits near Diwania are under detailed assessment for a cement plan and the results are expected to be ready in 2 or 3 months.

Banaskantha and Sabarkantha Districts (Summary) :

<i>Details of the area:</i>		<i>Reserves:</i>	
1.	Villages Sandoshi-Sonera Ranpur etc.	Limestone	71.1 Million tons upto a depth of 50'
2.	Village Pasual	Limestone	3.4 Million tons
3.	.. Diwania	do	5 million tons
4.	.. Karamudi	do	15 million tons
5.	.. Khunia Kotesar, Gaguwada Nandmatia etc.	do	0.2 million tons Reserves not down

(g) *Baroda and Panchmahal districts*.—The crystalline limestone that occurs in these district is dolomite limestone. This forms part of Champaner series of Aravalli system is associated with quartzites, phyllites and manganiferous. Cendite. The occurrence is restricted to the western or north western part of the districts. The colour of the dolomite is white, grey and greenish. It occurs as regular and extensive beds of considerable thickness. It is used for decorative purposes in buildings as "Motipura serpentinous marble".

(h) *Dohad taluka* : (*Panchmahals district*).—Outcrops of the Cretaceous limestone are spread over an area covering the villages Usarvan, Kharod, Doki, Chhapri, Mirakhadi in Dohad taluka, situated on the eastern boundary of the Gujarat State. The nearest railway station is Dohad at a distance of about 10-18 kms.

The outcrops consist of nodular limestone of the Lameta series having wide horizontal extension. The constituent rocks of the Lameta series are cherty and siliceous limestones, earthy sandstones, grits etc.

The Directorate of Geology and Mining made a reconnaissance survey of the areas mentioned above and found that the available limestone is of high grade and is quite suitable for the cement industry.

A few samples drawn from the area gave the following results :

	1	2	3
CaO	48.5%	45.0%	49.9%
MgO	0.6%	0.6%	1.6%
SiO ₂	10.7%	16.0%	7.0%
Fe ₂ O ₃	0.1%	1.3%	0.8%
R ₂ O ₃	0.5%	1.1%	0.2%
Loss on ignition	38.5%	32.0%	40.7%

A rough calculation of the estimate of the reserves worked out at 17.5 million tonnes.

It is hoped that in near future a cement industry may be set up in this region.

Dohad Taluka (Panchmahals district) (Summary) :

Details of the area.	Reserves
Villages Usarvan-Kharoda-Dohi-Chhapari	Limestone 17.5 million tonne's

(1) *Surat District*.—A nummulitic limestone deposit occurs close to the village Tarkeshwar in Mandvi taluka of Surat district. The village is situated at about 9 miles east of Kim a railway station on the Western Railway.

The exposures are found to occur at villages Velachas on the bank of river, Kim, Nowgama and Lindiad.

A well-consolidated limestone, either in the form of boulders in laterite, on horizontal layers, is found to occur below a thin covering of soil. It is slightly cavernous and the cavities are filled with clays, sands etc. At Tarkeshwar it is found in the form of massive blocks. To the north, the limestone is broken but to the South it is compact and well preserved.

The thickness, as revealed by bore holes, extends upto 100 feet, in the central portion of the area and decreased towards marginal areas.

The analysis of the limestone is as follows :

CaO	..	..	..	..	..	48.84%
MgO	..	..	..	..	..	3.20%
SiO ₂	..	..	..	..	..	2.60%
R ₂ O ₃	..	..	..	..	..	5.81%
Loss on ignition	..	..	..	..	..	38.12%

Reserves.—On the basis of the data collected by pit sinking, the reserves are estimated to be 7.5 million tons upto a depth of 12 feet.

Surat District (Summary)

Details of the area

Reserves

1. Village Tarkeswar, Nowgama & Lindiad Limestone 7.5 million tons approximately

(J) Kaira district :

Balasinor Taluka.—In this taluks, infra-trappean limestones are found to occur over extensive areas. The limestone available from the deposits analyses about 68.5% of CaCO₃. Since the quality is too poor for direct use in the manufacture of cement, the limestone is beneficiated by floatation process and utilized by the Associated Cement Company at their Sevalia Plant. The estimated reserves of the deposits are nearly 800 million tons according to Mr. P. N. Mukherjee. About two million tons of the material may be suitable for the Cement Industry.

Kaira district (Summary) :

Details of the area

Reserves

Balasinor Taluka

Limestone About 800 million tons out of which 2 million tons suitable for cement production.

(K) *Broach district.*—There are huge deposits of limestone in Broach district in the vicinity of Navagam dam site on the Narmada river. The limestone forms part of the Bagh beds of Cretaceous age. The deposits are spread over wide areas consistin of village Vandri, Vanji, Mokhadi, Gora-Limdi in Broach district.

The reports of analysis are as under :—

Places	CaCO ₃ %	MgO%	SiO ₂ %	Fe ₂ O ₃	Al ₂ O ₃	Loss on ignition%	ignition%
Gora		55.13	4.24	30.3	9.88	—	32.22
Kundna		60.56	2.35	23.4	7.98	6.52	—

The reserves are estimated to be about 68 million tons. But the limestone is of low CaO content and too high in silica content. Moreover beneficiation studies have indicated that the limestone cannot be beneficiated to the cement grade at an economic cost.

(1) *Rajkot district : Infra and Intertrappean beds of limestone.*—The limestone, of varying thickness, which some-times, reaches 50 or 60' is found to occur in a area occupied by the Deccan traps. In hand specimen, the limestone appears to be rather porous and is reported to contain about 80% CaCO₃. It is quarried for local use such as for plaster and mortar. There are also some deposits of sub-recent age containing bands of limestone. This is found to occur at Wakaner in Rajkot district. Further investigation to determine quality and quantity remains to be done.

Surendranagar District.—Limestone is also reported to occur from north-western part of the district around Dhrangadhra. The details about the quality, quantity etc. of the available limestone are not known.

ACTIVITIES OF THE DIRECTORATE OF GEOLOGY & MINING-GUJARAT STATE

With a view to carry out systematic assessment of the already known deposits and to locate new deposits of limestone in the State, the Directorate has taken up many schemes. During this field season (from October to May, 1965) three schemes to survey prospect and assess the limestone deposits occurring in Bhavnagar district, Kutch district and Banaskantha Sabarkantha districts were taken on hand. The details of the work done are as under :

(1) *Bhavnagar district*.—It has been already stated that during the field seasons of 1963-64, a reconnaissance survey of the area between North of Gopnath and South-west of Methla in Talaja Taluka of Bhavnagar district indicated the presence of 256.7 million tonnes of high grade limestone in an area measuring 12.25 sq. kms. During this field season detailed prospecting of the block mentioned above was done. In all 25 bore holes were drilled and total footage covered was about 1167.

In addition to this a reconnaissance survey was conducted over an area of 90 sq. kms. situated SW of Methla upto Katpur, South of Mahuwa. The area is spread over the following villages. Valar, Tali, Bambhor, Datha, Bhatkoda, Ketada, Katkoda, Dial, Kalsar, Bada, Naip, Taredi, Vaghnagar and Katpur.

The estimate of the deposits of limestone occurring in the areas is being worked out. The reserves appear very large.

(2) Another party carried on the work of assessing and proving the continuation of the limestone areas in Kutch district, as mentioned earlier.

The work has proved the availability of limestone spread over 70.82 kms, of areas in Abdasa and Lakhpat talukas of Kutch district.

The total deposits estimated in this area are of the order 100 million tonnes.

(3) The detailed investigations are in progress at Banaskantha Sabarkantha districts to prove the potentiality of the areas around Shri Amirgadh Railway Station. The results of the operation are awaited as the State Government proposes to set up a cement plant in this area.

(4) In addition to this a Forest Survey Scheme is on hand and new areas are being tapped for mineral resources in Baroda and Panchmahals districts.