

Appendices

APPENDIX - A

Industries – DIFFERENT CATEGORIES (*Product-wise Classification*)

1. Cement

Sl. No	Name	Product
1	Malabar Cement, Palakkad	Portland cement
2	Cochin Cements, Kottayam	Portland Pazzolona cement
3	Crescent Cements, Palakkad	Clinker Portland cement
4	Malampuzha Cements, Palakkad	Portland cement
5	Travancore Cements, Kottayam	White Cement Cement Paint Cement Primer Emulsion paint
6	Athulya Cement Pvt. Ltd	Ordinary Portland cement
7	Malabar building products Ltd.	Asbestos corrugated sheets, cultured marble products

2. Pulp and Paper Industries

Sl. No	Name	Product
1	Travancore Paper Mills Pvt. Ltd., Alappuzha	Empty Kraft paper (Natural shade)
2	Victory Paper & Boards, Palakkad	Kraft Paper / duplex board
3	Shree Sakthi Paper Mills Ltd., Thrissur	Duplicate board
4	Greenland Paper Mills Ltd, Kollam	Kraft Paper
5	RPC Paper Mills, Kollam	Kraft Paper
6	Mode Paper Mills, Thiruvananthapuram	Kraft Paper

7	Lin leathers Pvt. Ltd Ernakulam	Dressed Hides Known as wet blue
8	Kunneth Paper Mills, Palakkad	Paper
9	Cochin kadalas, Ernakulam	Kraft paper
10	Canara Paper Mills, Kottayam	Kraft Paper
11	Grasim Industries, Mavoor Kozhikode	
12	Hindustan News Print Ltd., Vellore	News Print
13	Sreesakthi Paper Mills, Pvt. Ltd Sreekailas, Ernakulam	Kraft Paper

3. Petrochemicals

Sl. No	Name	Product
1	Fertilizers and Chemicals, Tavancore, Udyogamandal, Ernakulam	Capralactum Byproduct – Ammonium Sulphate Solution, Nitric Acid (55%)
2	Hindustan Organic Chemicals, Ernakulam	Main Products Phenol, Acetone Hydrogen Peroxide Byproduct – Cumox oil Cumine Benzene

4. Fertilizers & Chemicals

Sl. No	Name	Product
1	Fertilizers and Chemicals, Travancore – Cochin division	Final Product NP- 20:20 Intermediate products : i) Sulphuric acid ii) Phosphoric acid iii) Urea

2	FACT, Udyogamandal.	Finished products i) Ammonium sulphate ii) Ammonium phosphate Intermediate product i) Ammonia ii) Sulphuric acid iii) Phosphoric acid
3	Always Fertilizers Industries Pvt. Ltd.	MgSO ₄ , ZnSO ₄ , H ₂ SO ₄ , Micronutrients, MgO ₂ etc.
4	Hindustan Insecticides Ltd.	DDT (Tech) BHG etc.

5. Sugar & Solvent

Sl. No	Name	Products
1	Co-operative Sugars Ltd., Chittoor, Palakkad	Sugar, Molasses, Pressmud Bagasse
2	Travancore Sugars Chemicals Ltd	Sugar
3	Gemini Solvents Pvt. Ltd.	Ethyl acetate
4	Nest food & Beverages Ltd	Mineral water
5	Oil palm India Ltd.	Palm oil, Palm nuts
6	Super star Distilleries & Foods Ltd.	Rectified spirit

6. Metallic and Nonmetallic Compounds

Sl. No	Name	Product
1	Travancore Cochin Chemicals, Ernakulam	Caustic soda Chlorine Hydrochloric acid Sodium Hypochloride Calcium Hypochloride

7. Dyes & Pigments

Sl. No	Name	Product
1	Jyothis Dyes Pigments, Uppuni, Pudur, Palakkad	Copper Phthalo Cyanine, Monocalcium phosphate
2	Kairali Dyes & Chemicals Pvt. Ltd.	Textile vat dyes
3	Pigments India Ltd.	Red oxide, Yellow iron serup, oxide, Blackoxide, middle sodium dichromate, ..Prussian blue, solvent etc.

8. Distillery

Sl. No	Name	Product
1	McDowel Distilleries, Alappuzha	Indian made foreign liquor
2	The co-operative sugars Ltd. Chittur, Palakkad	Alcohol

9. Thermal Power

Sl. No	Name	Product
1	Brahmapuram Diesel Power Plant	Electricity
2	Kasargod Power Corporation, Mylati Grama Panchayat, Kasargod	21MW thermal Power plant, Electricity
3	Kozhikode Diesel Power Project, Nallaalam, Kozhikode	128MW of electric power
4	National Thermal Power Corporation Ltd, Alapuzha	Electricity 268 Kl/day

10. Plastics

Sl. No	Name	Product
1	Kalyanam Plastics (P) Ltd	PVC fittings
2	ProfitCore Pipes Ltd	PVC pipes

11. Rubber

1	Elgi Rubber Products Ltd.	Rubber mixing, Ruberized curton, products like cushion and mattress, Coir fibre, rubber latex, chemicals, conveying materials
2	Hindustan Latex Ltd.	Condom, Copper T, Blood bags, gloves, Latex, PVC, silicron oil, needles, foliate
3	Intermix Factory	Rubber mixing
4	Kandeo Polymer Pvt. Ltd	Hospital sheets, prerubber sheets, hollow mats, rubber, rubber chemicals etc.
5	Kerala Rubber and Relcain Ltd	Reclained rubber, rubber compound, used rubber, natural rubber
6	Malanadu Latex India Pvt. Ltd	Centrifuged latex
7	Merehen Ltd	Rubber Chemicals
8	Quality mix (India) Pvt Ltd.	Mixed and masticated rubber compounds,
9	The Palakkad Dist. Co-Op Natural rubber	Natural rubber

12. Clay Factories

Sl. No	Name	Product
1	English Indian Clays	China clay (refined)
2	Kannur Bricks & Blocks (P) Ltd.	Clay based building materials
3	Kerala Clays and Ceramic Products Ltd.	Clay bricks
4	Cochin Clays & Minerals Pvt.Ltd.	Chemically treated bleached clay

13. Carbohydrates/ Soaps/ Fatty acids

1	Gujarat Injects (Kerala) Ltd	Dextrose, PWS, NSRL, Lactic acid, mannitol, NaCl etc, Plastic materials, glass bottles etc.
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2	Tapioca Products Ltd,	Dry starch
3	Hindustan Lever Ltd.	Toiletries, Vanaspathy, fatty acids
4	Hindustan Newsprint Ltd	New print, printing and writing paper
5	Kannor Flavours and Extracts Ltd.	Raw oils, refined oils, fatty acids.
6	Kerala Soaps & Oils Ltd.	Toilet, laundry product
7	Kerala State Detergents & Chemicals Ltd.	Cleaning powder, HPP, LD, LC

14. Chemical / Chemistry applied Industries

Sl. No	Name	Product
1	Grasim Industries	Rayon Grade pulp
2	Manorama Oxygen Pvt. Ltd	Industrial Oxygen
3	Nagarjuna Herbal Concentrates Ltd.	Thylam, Medicinal herbs / raw dyes etc.
4	The Chalakkudy Refractories	Refractory
5	The Co-op. Sugar Pvt. Ltd.	Sugar, rectified spirit
6	The Kerala Chemicals Ltd.	Porcelin, Kaolin
7	The Travancore Sugar & Chemicals Ltd.	Sugar, rectified spirit

15. Minerals & Metals

Sl. No	Name	Product
1	Indian Aluminium Co. Ltd	Aluminium
2	Indian Rare earth Ltd, Chavara	Ilmenite
3	Indian Rare earth Ltd, Udyogamandal	Rare earth chloride, Trisodium phosphate
4	Indo German Carbon Ltd	Granular activated carbon
5	Kerala Minerals and Metals Ltd.	TiO ₂ , Rulite, Ilmenite

6	ABN Granite Ltd.	Granite metal products
7	Binani Industries Ltd.	Zinc ingots, glass, fibre, sulphuric acid
8	Carborandum Universal Ltd.	Al ₂ O ₃ grains, Refractories , Electrominerals
9	Cochin Minerals & Rutile Ltd	Synthetic Rutile , HCl acid, Ferric chloride

16. Pharmaceuticals

Sl. No	Name	Product
1	KSDP Ltd.	Capsules, Powders, Liquids, Parenterals, Tablets, Aspirin, Amipicilin, Starch, Benzyl, Benzol, Cardamom, Paracetamol
2	KSSC	Aspirin
3	Malabar Organics Ltd.	Methyl Dopa, Ibuprofen
4	Mc Glan Pharmaceuticals Pvt.Ltd	Pharmaceuticals Ltd., Dextrose, Lactic acid, mannitol, Sodium plastic materials, glass bottles
5	The Pharmaceutical Corp. Kerala Ltd.	Arishtam, Thylam
6	The Thomson Drugs & Chemicals Ltd	Chlorogin, Novaldiaminephenol, Phos-oxy-chloride, Phosphoicacid

17. Carbon

Sl. No	Name	Product
1	Keltron Resistors Ltd.	Carbon & Metal film resistors
2	Philips Carbon Black Ltd.	Carbon Black

18. Refineries

Sl. No	Name	Product
1	Southern Refineries Ltd.	Base oil, lubricating oil, rubber processing
2	Cochin Refineries Ltd.	Crude oil processing, Crude oil

19. Polymer

Sl. No	Name	Product
1	Cochin Balmer Lawrie Ltd	Poly isobutane
2	Cum Polymers Pvt Ltd	Centrifuged latex, skin rubber

20. Organic compounds/ Inorganic compounds

Sl. No	Name	Product
1	Hindustan Organic Chemicals Ltd	Phenol & Acetone
2	MOAL Kerala Nitrous Ltd.	Nitrous oxide
3	Periyar Chemicals Ltd	Formic acid Caustic Soda, H ₂ SO ₄ ,
4	Sai Krishna Organics (P) Ltd	Paracumyl phenol Cumox, waste oil
5	Synthetic industrial Chemicals Ltd.	Oleoresin species
6	TamilNadu Ammonia Pvt. Ltd	Liquid ammonia
7	Travancore Ltd, Cochin.	Chlorine, Caustic soda, common salt, sodium sulphate.

APPENDIX B

DATA ANALYSIS SHEET FOR INDUSTRIES

(The General Performa)

Name of student

Std.

School

Name of the Industrial environment:

Factory details

Category of industry

Locality and features of the site

Division of production units

Manufacturing processes - Details.

Raw materials used

Major products / byproducts

Technological devices used

Technical processes involved

Scientific processes involved (Give descriptions)

Stages involved in the manufacturing process.

No. of stages of production. :

(Enter details of all stages of production using separate sheets for each stage).

Stage I.

Process :

(i) Raw materials used for production :

Name:

Physical form:

Colour and appearance:

Solubility:

(ii) Machines or equipments used -

Name:

Capacity or size:

Purpose:

(iii) Processes used for production

a).

b).

c).

(iv) Changes taking place during these processes

Physical:

Chemical:

Electrical:

Mechanical:

(v) Principles behind or towards which the processes are leading to

(vi) Quantity or ratio of materials used (specify)

(vii) Activities or skills involved in the process

a).

b).

c). No. of persons involved:

d). Time (approximate) taken to complete the process

e). Any other details:

(viii) Methods of

Purification:

Collection:

Refining:

- (ix) Precautions taken during mechanical operations
- (x) Safety measures observed in the environment
- (xi) Types of reactions involved in the processes
- (xii) Factors affecting or governing the processes.
- (xiii) Limitations, defect or deficiencies of the processes and equipment
- (xiv) Final product:
 - Nature:
 - Appearance:
 - Quality:
- (xv) The formula
 - Structure (if available):
 - Strength :
- (xvi) Utility of final product

Details of analysis – Reflection session.

- (xvii) Scientific concepts of principles behind each and every reactions or activities
- (xviii) The possible errors that may occur during these processes.
- (xix) The modifications suggested by the staff or students.
- (xx) Any other relevant information

Products –uses and applicability

Type of pollution caused by the industry

Consolidation of the details collected.

APPENDIX C

Lesson Transcripts for ATL

Topic: Preparation and properties of Cement.

Subunits.

Sub Unit I	Composition of Cement
Sub Unit II	Manufacture of cement
State(i)	grinding of raw materials using either dry process or wet process
Stage (ii)	Production of cement linker
State (iii)	Production of cement
Sub Unit III	Setting and hardening of cement
Sub Unit IV	Concrete
Sub Unit V	Properties of white cement
Sub Unit VI	Preparation of Portland cement
Sub Unit VII	Plaster of Paris – preparation and properties
Sub Unit VIII	Lime – Manufacture and properties
Sub Unit IX	Cement paint
Sub Unit X	Preparation and properties of metallic calcium

Description of lessons

Sub unit I

- Name: i) Cement Industry in India – particularly in Kerala
 ii) Types of Cement – Composition of Cement

Std. XI

No. of Students –60

Preliminary Information

Pupils know that cement is used for construction purposes. They may know some of the major cement industries in Kerala. They may be familiar with the raw materials used for the production of cement and they may know the uses of these materials in daily life. They may be knowing some of the chemical reactions of these materials.

Specific Objectives

Students will be able to develop

- I Knowledge of
 - i) Facts (I) & (X) in the unit plan
 - ii) Concepts (i), (ii) & (iii) in the unit plan
 - iii) Generalisation (i)
 - iv) The major cement industries in Kerala
 - v) The machines and technological gadgets used in the industries.
- II Understanding by
 - i) items (i), (ii), (iii) in the unit plan
 - ii) identifying and comparing the different types of cement in ordinary cement or portland cement, white cement and coloured cement
 - iii) the way in which the different types of cement can be identified.
 - iv) identifying the composition of cement - cement is a mixture of calcareous and argillaceous materials and there exists or the production necessitates a fixed ratio between these materials.
- III Application of Knowledge gained in
 - i) finding the components of different types of cement
 - ii) identifying the uses of different types of cement
 - iii) item (vii) in the unit plan.

IV Skills like

- i) observation skill
- ii) acquisitive skills like inquiring, searching and locating sources, investigating background information, etc.
- iii) Communication skills like asking questions, discussion, explanation, writing a report of an experiment or demonstration, etc.
- iv) Cognitive skills including
 - a) recall of knowledge and procedure
 - b) providing him or her own examples, perhaps by reporting his or her own observation and experience in terms of new connection made
 - c) application of knowledge gained in a novel situation
 - d) interpreting information
 - e) evaluating ideas of another person
- v) Skills in critical thinking by distinguishing between facts and opinions, regarding the processes used in the manufacture of cement.

V Creativity through

- i) Developing a plan of action for further learning

VI a positive attitude towards collaborating industry with education.

VII Value human labour and evaluate role of education in promoting it.

Aids used

- i) Charts showing cement industries in Kerala
- ii) Slides showing composition of cement
- iii) Dioramas, Chemicals etc.

LESSON PLAN FOR ATL

Phase I – Procedure Design Phase

Introduction

In this unit, a general picture of the cement industry in India – especially in Kerala - is presented by the teacher. Pupils identify the location of cement factories in Kerala and are made familiar with the major product or type of cement manufactured in these factories.

	Learning Experiences	Learning outcomes *
i)	Pupils are made familiar with the origin of cement. They recognise that it was discovered in England and was like the famous Portland rock of England and named as Portland cement	identifies the origin (K) recognises the naming (K)
ii)	With the help of teacher, pupils identify the major cement industries in India, especially in Kerala	locates (A)
iii)	Pupils locate the two factories in Kerala, ie. one Malabar Cements at Walayar and Travancore cements in Kottayam. They recognise that two types of cement are produced in these factories ie. ordinary cement is produced in Malabar Cements and white cement is produced in Travancore Cements	recognises (K) identifies (K) identifies (U)
iv)	Pupils observe the samples of two types of cements shown to them. They identify the physical features such as colour, smell, appearance, texture, etc. They compare these features	observes (U) identifies (U) distinguishes (U) compares (K) differentiates (A)

v)	With the help of teacher they infer that the two types of cement slightly differ in their components and composition	infer (A)
vi)	Pupils recall that cement is used for construction purposes and it forms strong structures when mixed with water	recalls (K) states (K)
vii)	Pupils identify that cement is prepared from a mixture of calcareous and Argillaceous compounds. They recognise that commonly used raw materials are limestone and clay	identifies (U) recognises (K) identifies the sources (K)
viii)	With the help of teacher pupils prepare a chart showing the constituents or components present in raw materials Calcareous materials [CaO] Argillaceous materials [SiO ₂ + Al ₂ O ₃)	observes (U) recognises (K) identifies (U) compares (U) infers (U)
ix)	Pupils identify that powdered coal or fuel oil is used for ignition and gypsum [CaSO ₄ . 2H ₂ O] are the other two raw materials used	identifies (U) recognises (K)
x)	Pupils observe the slide shown by the teacher indicating the ingredients and then function. They recognise the formula, composition, their structure compares their functions etc. a) CaO – principal constituent, its (50-60%) quantity is regulated b) SiO ₂ – Imparts strength to cement	identifies (U) recognises (K) infers (U)

	<p>c) Al_2O_3 – Quick setting property</p> <p>d) CaSO_4 – Retards the initial setting property</p> <p>e) Fe_2O_3 – Colour, strength and hardness (1-2%) to cement</p> <p>f) SO_3 – Soundness to cement</p> <p>g) Alkalies - Small amount provides good qualities to cement</p>	
xi)	Pupils analyse the relative composition of each component. They recognise that the ratio between silica to alumina lies between 4 and 2.5 while that of Calcium oxide to silica + alumina ferric oxide should be as close to 2 as possible.	<p>identifies the relative composition (U)</p> <p>infers (U)</p> <p>compares (U)</p>
xii)	With the help of teacher, pupils reason out why this ratio is maintained. They identify that if lime is in excess, the cement cracks during setting and if lime is less than required by the above ratio, the cement is weak in strength	<p>reasons out (A)</p> <p>analysis (A)</p> <p>interprets (A)</p>
xiii)	Pupils explain how different types of cement are prepared ie. it may be due to the variation in the relative proportion of ingredients	<p>explains (U)</p> <p>compares (U)</p> <p>differentiates (U)</p>

(Note: K denotes the objective - Knowledge, U – Understanding and A – Application respectively).

Phase I – Part II

Sixty students of class XI of Catholicate H.S. school, Pathanamthitta are taken to the cement factory, Travancore Cements, Kottayam. They are informed that they are going to learn the manufacture of cement by observing the activities and procedures in the factory and practising these activities along with the workers, ie, in an apprenticeship-type mode. For that they have to observe the processes and procedures carried out in the factory, identify the skills required to perform the activities, the physical and chemical processes and changes taking place, safety measures observed, and all such relevant points. A plan of action for Apprenticeship-Type Learning is then prepared.

Students are divided into 6 groups A, B, C, D, E & F, each group having 10 students each. Each group is assigned to work under the supervision of a member from among the staff. Each member of the group has to work independently within the group without losing group consciousness. The overall monitoring is done by the teacher. Rotation of activities within groups is done to ensure that all students complete each and every activity.

Pupils observe carefully how the manufacture of cement is carried out in the factory. They identify the things and processes used, its structure, composition, quality, etc. the basic principles of production yield of cement etc. and prepare a list of things to be observed and noted. They prepare a sketch of the process of manufacturing of cement.

Phase II – Observation and Activity Phase

I - Learning Environment – Observation by Students

Introduction

Pupils are familiar with the raw materials commonly used in cement industry. Pupils recognize that white cement is manufactured in the factory with the trade mark. ‘VEMBANAD White Cement’. Students are then asked to make a thorough observation of the procedures going on in the factory.

	Learning Experiences	Learning outcomes
1	Pupils observe the raw materials- colour, size, appearance, strength etc. used for the manufacture of cement	Observes (S) Identifies the physical properties (U)
2.	With the help of staff pupils identify the sources from which the raw materials are obtained The calcareous material used is the special quality shell drudged from the sea. It is 98-99% pure CaCO_3 with very little amount of impurities	recognises the source (k) identifies (U)
3.	They recognise that instead of limestone, shell is used as the source of CaO	distinguishes (U)
4.	Pupils identify that iron content in shell is very less than that in limestone and hence shell is used for producing white cement	infers (U)
5.	From this pupils infer that metallic compounds having colour can add colour to cement	infers (U) interprets (U)
6.	Pupils recognise the other raw materials used as white clay or China clay obtained from Thonnakkal in Trivandrum District and white sand called Cherthala sand obtained from the sea shore near Cherthala in Alappuzha district	identifies (U) recognise the source (K) names (K)
7.	Pupils observe the physical properties of these raw materials and identify that these materials contain very little amount of colouring pigments and are hence used for manufacturing white cement	observes (S) identifies (U) compares (U) infers (U)

8.	<p>Pupils observe and record the following things</p> <p>Amount of raw materials used</p> <p>Gaining of materials</p> <p>Machine used – Rotating</p> <p>Process used – wet process</p> <p>Time taken to complete the process</p> <p>nature of product</p>	<p>observes (S)</p> <p>records (U)</p> <p>compares weight (A)</p>
9.	<p>Pupils identify that slurry is obtained after grinding and there exists a fixed ratio of silica to alumina in this slurry</p>	<p>Identifies (U)</p>
10.	<p>Pupils identify that white gypsum obtained from Thoothukkudi is added to the slurry to attain the required composition of cement, they recognise this process as blending of slurry</p>	<p>recognises (K)</p> <p>names (K)</p> <p>explain (U)</p>
11.	<p>Pupils identify that burning of this mixture gives the product called cement clinker</p>	<p>Identifies (U)</p>
12.	<p>Pupils identify the physical characteristics of cement clinker. They analyse the composition of cement clinker</p>	<p>Identifies (U)</p> <p>analysis (A)</p>

II - Learning through Apprenticeship

Here pupils have very little opportunity for motor activities. They have to observe and record the activities only. They have then to deduce idea from their observation of learning environment.

By monitoring the work of students, the teacher and staff analyse this skill in observation, communication, recording of activities, etc. Pupils are asked to prepare a detailed report of their observation of the learning environment. They are encouraged and asked to clear doubts regarding their observation.

Phase III - Reflection and Idea generating Phase

I – Discussion on student record of activities

In this phase, pupils present their ideas from observation of the learning environment. They analyse their observation, critically evaluate and interpret ideas, deduce concepts, extrapolate ideas and arrive at conclusions. They develop a cognitive apprenticeship type learning by

- i) reporting their observations or experiences in everyday terms
- ii) picking out, restating or remembering important facts, concepts or principles that have been presented.
- iii) distinguishing between given examples and non examples for the various chemical compound, chemical reactions, industrial processes, etc.
- iv) providing their own examples – for the various types of processes, reactions, etc.
- vi) applying the new concepts / principles (plus native wit and personal experience) to analyse interpret or plan a new situation.

Point I: Pupils discuss why shell is used instead of limestone for preparing white cement. With the help of the teacher pupils identify that shell contains about 99% of CaCO_3 and only very little amount of Iron which is responsible for the colour of cement. From this they infer that coloured cement can be prepared by adding metals having coloured compounds, to the cement.

Point II - Pupils discuss the qualities of white clay and white sand used.

They extrapolate the idea that china clay is used for the preparation of Titanium dioxide in Travancore Titanium products, Trivandrum.

Point III: They notice the point that raw materials are not accurately measured before mixing. So there may be some other means for estimating the composition.

Point IV: They inquire why wet process is used than dry process. With the help of teacher pupils identify that dry process requires more fuel for evaporation, which makes production more expensive.

Point V: Pupils discuss the nature of cement clinker obtained, i.e. physical properties and compares these to that of cement.

Point VI: Pupils discuss why gypsum is added to cement clinker. i.e. to reduce the initial setting property.

Point VII: Pupils are asked to express their attitude towards learning the unit in an industrial setup than in school.

Point VIII: Pupils suggest the possible reactions that may take place during the preparation of cement.

Additional points, if any:

II Rectification of errors and remediation

During discussion and analyzing the report teacher locates errors and suggests remedial measures. Pupils then list out the concepts developed during the above phases. Teacher motivates pupils to present their own ideas, identify additional points and suggest alternative concepts.

III Conclusion and Summary and Learning

Pupils are asked to prepare a summary of their learning and suggest new areas of study or further use of the concept developed.

Phase IV - Evaluation and extension.

Formative evaluation is done during learning. The reports are evaluated and the observations are consolidated in a scoring sheet.

SUB UNIT II – MANUFACTURE OF CEMENT

Objectives

Pupils will be able to develop

I. Knowledge of

facts regarding composition of cement

II. Understanding by

- i) Identifying the chemical reaction involved in the manufacture of cement
- ii) Recognising the factors determining the rate of chemical reactions.
- iii) Identifying the variables and their manipulation in the manufacture of cement
- iv) Observing the activities of technicians and labourers in the work spot.
- v) Identifying the precautions to be carried out in the manufacture of cement
- vi) Estimating the yield of cement

III Application of knowledge gained in

- i) Explaining the importance of different chemical reactions in other relevant situations.
- ii) Using the skills developed in other situations
- iii) Identifying other problems solving situations forming hypotheses and identifying strategies to solve them.

- iv) Suggesting better ways and means for increased production and quality of cement.
- v) Identifying better safety measures for industries.

IV. Skills like

- i) Acquisitive skills
- ii) Organisational skills
- iii) Creative skills
- iv) Manipulative skills
- v) Communication skills

V. Positive and constructive attitude towards

- i) Learning more about science and technology
- ii) Knowing about growth of industries and then relevance
- iii) Selecting skilled jobs

VI) Interest in

- i) Identifying the properties of cement
- ii) Identifying better and economic use of cement

Aids Used

Chemicals and Utensils

Machines and equipments in the work spot, OHP, projection gadgets etc.

Syntax

Phase I - Procedure Design Phase

Previous knowledge

Pupils are familiar with the major sources from which cement is manufactured. They knew the relative proportion of different constituents of

cement. They are able to explain the different chemical reactions involved in the manufacture of cement

Learning Experience

Learning outcomes

Pupils recognise the raw materials used for the manufacture of cement as clay and limestone. They identify that production of cement is carried out in three stages

recognizes (K)
identifies the chemical reaction (U)
Identifies the different stages (U)

Stage I - Grinding of raw materials using either dry process or wet process

Pupils identify that there are two different processes used in the initial stage of manufacture of cement

identifies (U)
infers (U)

They recognise the characteristics of dry process and wet process

recognises (u)

Pupils explain the characteristics of dry and wet process with the help of teacher

explains (U)

Pupils compare the two processes and infer the similarities and differences

compares the characteristics (U)
explains (U)
infers the features (U)

They explain the use of the method and its relevance in the manufacture of cement

explains (A)

Pupils identify when and why these two processes are used in different situations

identifies (U)
distinguishes (U)

Pupils observe the work of people in the factory in carrying out these processes

Infers the different types of activities (U)

Stage II - Production of cement Clinker

Clinker

Pupils identify that after grinding the raw materials, they are subjected to a series of chemical reactions under the application of wide range of heat. They identify the different stages in these chemical changes and infer the nature and properties of different products formed. They develop equations for every chemical reaction

identifies (U)
infers (U)
explain (U)
compares (U)
identifies reaction (U)
explain characteristics (U)
predicts the nature and role of compounds (A)

Pupils identify how cement clinker is different from cement

differentiates (U)

Stage III - Production of cement

Pupils identify that cement clinker is converted to cement by the addition of gypsum. They recognize the function of gypsum. They explain how it helps in hardening of cement	identifies (U) recognises (U) infers (U) explain (A)
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Planning and Preparation for ATL

There are 5 groups of students A, B, C, D & E. Each group consists of 10 students. One or two members from among the staff will be guiding and assisting students in their activities. Students are provided with learning materials – things that are to be observed and recorded in each and every activities. Each student has to work independently without losing group consciousness. Teacher explains the different steps to be followed while carrying out activities. The factors that are to be taken into consideration while carrying out the activities like quantity of chemicals, taken, purity of these materials, mechanical and manual operations that are to be done, controlling variables, precautions to be taken, safety measures to be observed, the quantity and quality of products etc. are informed to students. Pupils are asked to clear their doubts and are motivated to learn through ATL.

Learning environment – Observation by Students

Students identify the different stages involved in the manufacture of cement. They observe the materials used in each stage, processes and principles used, machines and equipments used, the changes taking place, the work of labourers etc. They note the time taken to complete the processes, skills required to progress in activities, the quality and quantity of products etc. They try to correlate the experience gained from undertaking activities in school, laboratory etc. to enter into and progress in different activities in school, laboratory etc. Students are motivated to develop their self-confidence to learn through apprenticeship.

Learning through Apprenticeship

Introduction: Pupils identify the different stages in the manufacture of cement, by following the instructions given by the workers they engage themselves in the different activities associated with each stage of production.

Concepts

Dry Process

Wet Process

Science Skills

Observing, classifying, manipulating,

hypothesizing, controlling variables

Math and mechanical skills practised

- i) computing equations
- ii) measuring weight, volume etc.
- iii) weighing
- iv) manipulating machines and equipments etc.

Activities – Part I

Learning outcomes

Step I. Engagement

Pupils are made familiar with the new learning situation by making connections between past and present learning experience. Pupils decide whether dry process or wet process is to be used for grinding raw materials

Pupils identify the different activities and try to analyze them based on their previous knowledge

recalls the composition of cement (K)

identifies the nature of raw materials (k)

selects either wet process or dry process (A)

explains the different processes (U)

develops an approach to the instructional task (A)

analyses situations (A)

Selects an experimental procedure(A)

Step II – Exploration

With the help of the teacher, pupils acquire a common base of experiences within which current concepts, processes and skills may be identified and developed. The processes and procedures to be followed, the sequence of activities that are to be followed in the grinding process, nature of raw materials and the changes taking place are being explained to the students

With the help of labourers pupils identifies the working condition, precautionary measures and the procedures for collection, weighing etc. in the work spot

identifies experiences (U)
infer the procedures, process it (U)
evaluates the situation based on previous knowledge (A)
observes the work of labourers (S)
analyses the changes (A)
makes accurate observations (S)
gathers data (S)
means of execution (S)
picks out important items (S)
locates new problems (A)
observes different techniques (S)

Step III Explanation

Students are provided with opportunities to demonstrate their conceptual understanding process skills or behaviour. Pupils describe their understanding, use their skills and express their ideas. They work along with the labourers, use the skills and progress in their activities. Teacher directs student learning by clarifying misconceptions, giving examples of skills, modifying behaviour and suggesting further learning

compares and contract the new knowledge with existing knowledge (U)
organises date (S)
reviews (S)
sets hypotheses (S)
synthesises new knowledge (S)
manipulates instruments (S)
cares for an instrument by

experiences. Teachers facilitate and monitor interactions between students and institutional situation and materials. The pupils complete activities directed toward learning outcomes

handling properly (S)
demonstrates (S)
apparatus work (S)
illustrates scientific principles (U)
use safe working procedures (S)

Step IV Elaboration

Students are provided with opportunities to extend their conceptual understanding and skills. They explain the chemical reactions involved in the science process, the rationale for using dry process or wet process, importance of grinding raw materials etc. Pupils present and defend their explanations and identify and complete several experiences related to the learning task. Activities provide experiences through challenges, repetition, new activities, practice and time

explains procedures (U)
justifies the sequence of activities (A)
interprets the data (S)
arrives at conclusion (S)
analyses the use of methods (A)
justifies the use of procedure (S)
identifies important facts (U)
explains several procedures (S)
repeats different activities (S)

Step V Evaluation

Students are encouraged to assess their understandings and abilities and examine the adequacy of their explanations, behaviour and attitudes in new situations. Pupils repeat different phases of the teaching model to improve conceptual understanding and skills

evaluates concepts (A)
assesses activities (S)
explains procedures (S)
develops attitude (S)
draws conclusions from results (S)

Checking the progress

Teachers use a variety of formal and informal procedures for assessing student understanding. The progress of each and every activity is checked by asking questions, removing misconceptions, rectifying defects, reporting of concepts, procedures etc.

Reporting of the work

Pupils are asked to prepare a detailed report of daily activities. They are expected to report results of their activities.

Phase III - Reflection and Idea generating Phase

I – Discussion on student record of activities

In this phase, pupils present their ideas from observation of the learning environment. They analyze their observation, critically evaluate and interpret ideas, deduce concepts, extrapolate ideas and arrive at conclusions. They conduct simple experiments in the laboratory to verify the concepts they learned from the industrial environment. The observations are consolidated to formulate concepts and generalizations.

Pupils thus generate concepts regarding the following topics:

Point I - Setting and hardening of cement – the presence adequate amounts of gypsum in cement.

Point II - Concrete – preparation and properties – mixing cement with water and sand – setting properties – heat of hydration.

Point III - Properties of white cement – brilliant whiteness, properties as a pigment, uses.

Point IV - Preparation of Portland cement – based on the preparation of white cement – differences between the two in the preparation, properties and uses.

Point V - Plaster of Paris – preparation, properties and uses – properties and uses of gypsum

Point VI - Lime – Manufacture and properties – common uses.

Point VII - Cement paint – properties and uses.

Point VIII - Preparation and properties of metallic calcium – preparation and properties of alkaline earth group of elements.

II Rectification of errors and remediation

During discussion and analyzing the report teacher locates errors and suggests remedial measures. Pupils then list out the concepts developed during the above phases. Teacher motivates pupils to present their own ideas, identify additional points and suggest alternative concepts. Teacher guides students in conducting experiments and recording observations.

III Conclusion and Summary and Learning

Pupils are asked to prepare a summary of their learning and suggest new areas of study or further use of the concept developed. Pupils are directed to prepare a comprehensive report of entire activities of learning and submit for evaluation.

Phase IV - Evaluation and extension.

Formative evaluation is done at every stage of learning. The reports are evaluated and the observations are consolidated in correlation with the evaluation of performance skills. The reports are to be used for learning other related topics.

APPENDIX D
ACHIEVEMENT TEST I
(Content Achievement Test)

Time : 45 min.

Max: Marks: 25

I. Choose the correct answer

1. Hardening of cement is due to
 - a) Hydrolysis
 - b) Polymerization
 - c) Dehydration
 - d) Hydration and hydrolysis
2. The substance which on treating with chlorine, yields bleaching powder is
 - (a) Quick lime (b) Slaked lime
 - (c) Lime stone (d) Gypsum
3. Portland cement consists of
 - (a) CaO, SiO₂, SO₃ and Fe₂O₃
 - (b) CaO, SO₃, MgO, Na₂O
 - (c) SiO₃, MgO, Na₂O, SO₃
 - (d) CaO, SiO₂, Al₂O₃, Fe₂O₃, MgO, SO₃, Na₂O
4. Setting (hardening) of Plaster of Paris involves
 - (a) Oxidation with atmosphere oxygen
 - (b) Combination with atom CO₂
 - (c) Hydration yielding another hydrate
 - (d) Dehydration
5. Gypsum is added to clinker during cement manufacture of
 - (a) decrease the rate of setting of cement
 - (b) to make the cement impervious
 - (c) bind the particles of Calcium silicate
 - (d) to facilitate the formation of colloided gel.
6. Which is used is the preparation of Portland cement?
 - (a) Lime stone, clay and sand
 - (b) Limestone, gypsum and sand
 - (c) Limestone, gypsum and alumina
 - (d) Limestone, clay and gypsum

7. Concrete is a mixture of
 - (a) Cement, lime and water
 - (b) Cement, sand and water
 - (c) Cement, sand, gravel and water
 - (d) Cement, slated lime and water
8. Which component of cement sets at the lowest rate
 - (a) Dicalcium silicate
 - (b) Tricalcium silicate
 - (c) Tricalcium aluminate
 - (d) Tetra calcium aluminoferrate
9. Cement sets better with water and hardens well on dampening because the material that gives hardness to cement consists of
 - (a) Limestone
 - (b) Stable salts
 - (c) Hydrated salts
 - (d) Water absorbing stones
10. Plaster of Paris is hard in nature due to
 - (a) Crystallization
 - (b) Hydration
 - (c) both
 - (d) None of these
11. Calcium is obtained by
 - (a) Electrolysis of molten CaCl_2
 - (b) Electrolysis of solution of CaCl_2 in water
 - (c) Reduction of CaCl_2 with carbon
 - (d) Roasting of limestone
12. The best dehydrating agent for commercial purposes is
 - (a) Con. H_2SO_4
 - (b) CaCl_2
 - (c) P_4O_{10}
 - (d) Silica gel
13. The difference of water molecule in gypsum and Plaster of Paris is
 - (a) $5/2$
 - (b) 2
 - (c) $1/2$
 - (d) $3/2$
14. The crack formation and flaking of cement happens due to the presence of high content of
 - (a) Silica
 - (b) Magnesia
 - (c) Alumina
 - (d) Lime
15. Rate of setting cement can be increased by adding
 - (a) NaCl
 - (b) KCl
 - (c) BaSO_4
 - (d) CaSO_4
16. Lime stone is
 - (a) CaO
 - (b) Ca(OH)_2
 - (c) CaCO_3
 - (d) CaSiO_3
17. A metal sparingly soluble in water and its carbonate evolves Carbon dioxide on heating, the metal is
 - (a) An alkali metal
 - (b) A noble metal
 - (c) An alkaline earth metal
 - (d) A transition metal
18. Which of the following is a correct statement?
 - (a) Gypsum contains lower percentage of water than plaster of Paris

- (b) Gypsum is obtained by heating POP
 - (c) Gypsum can be obtained by hydration of Plaster of Paris
 - (d) Plaster of Paris is obtained by partial oxidation of gypsum
19. When CO_2 is passed into $\text{Ca}(\text{OH})_2$ solution, a white precipitate is formed due to the formation of
- (a) CaCO_3
 - (b) $\text{Ca}(\text{HCO}_3)_2$
 - (c) CaC_2
 - (d) $\text{Ca}(\text{NO}_3)_2$
20. Alzheimer's disease is due to
- (a) deposits of Al salts in the brain
 - (b) deposits of Cu salts in the brain
 - (c) Na^+ ions imbalance
 - (d) All of these

II Write whether the statements are True or False by marking T or F

21. Marble is a common form of CaCO_3
22. Slaking of lime produces Calcium hydroxide
23. Anhydrous Calcium Sulphate is known as Plaster of Paris
24. Clay is a mixture of aluminates and silicates
25. Setting of cement is enhanced by adding water on it

APPENDIX E
ACHIEVEMENT TEST I
Content Achievement Test
Scoring Key

1	d	11	a	21	t
2	b	12	b	22	t
3	d	13	d	23	f
4	c	14	b	24	t
5	a	15	d	25	t
6	d	16	c		
7	c	17	c		
8	c	18	c		
9	c	19	a		
10	b	20	a		

APPENDIX F
ACHIEVEMENT TEST - II
(Industry-based Learning Test)

Time : 45 min.

Max: Marks: 25

1. A form of Carbon used for refractory lining is
a) charcoal b) coke c) carbon black d) graphite
2. Sand is ground along with water in the
a) Wash mill b) Ball mill
c) Cement mill d) Kiln
3. The main constituent of egg shells is
a) CaCO_3 b) CaSiO_3 c) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ d) $\text{Ca}_3(\text{PO}_4)_2$
4. Mortar is a mixture of
a) quick lime and lime stone b) slaked lime and water
c) slaked lime, sand and water d) none of these
5. Which of the following is not a cement producing state in India
a) Rajasthan b) Orissa c) Goa Gujarat
6. Plaster of Paris in contact with water sets to a hard mass whose composition is
(a) CaSO_4 (b) $\text{CaSO}_4 \cdot \text{H}_2\text{O}$
(c) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (d) $\text{CaSO}_4 \cdot \text{CA}(\text{OH})_2$
7. A substance absorbs CO_2 and violently reacts with water. The substance is
(a) CaCO_3 (b) CaO (c) H_2SO_4 (d) ZnO
8. The function of sand in mortar is
(a) to decrease the hardness (b) to make the mass compact
(c) to decrease the plasticity of the mass
(d) to prevent the excess shrinkage because of which cracks may result
9. The formula of Plaster of Paris is
(a) $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ (b) $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$
(c) $\text{CaSO}_4 \cdot \text{H}_2\text{O}$ (d) $\text{CaSO}_4 \cdot 3\text{H}_2\text{O}$
10. In which of the following pair, both the substances are chemically the same?
(a) Milk lime and semi water
(b) Dead burnt plaster and gypsum

- (c) Alumina and gypsum
- (d) Gypsum and Plaster of Paris

Fill in the blanks

11. White clay contains
12. Sand is a mixture of
13.is used to collect lime shell from the lakes
14. VEMBANAD White Cement has the high content of and which make it possible for the cement paint to set quickly
15. is prepared in the Wash mill
16. Cement clinker is cooled before adding gypsum to avoid
17. Brand name of Cement Paint prepared in Travancore Cements is
18. Slurry is stored in
19. In the preparation of slurry, the proportion of sand, clay and lime is adjusted using
20. Raw mill is used for
21. The oxides provided by clay in the manufacturing of cement are.....
22. Wet process and dry process differ in the presence of water during
23. Clinker is prepared in the
24. The chemical formula of Plaster of Paris is
25. gas is prepared by the decomposition of lime stone

APPENDIX G
ACHIEVEMENT TEST - II
Scoring Key

1. d
2. b
3. a
4. c
5. a
6. c
7. b
8. d
9. b
10. a
11. Hydrated aluminium silicate
12. SiO₂ and silicate
13. Dredger
14. Tricalcium silicate and Aluminate
15. Clay slurry
16. The conversion of Gypsum to Plaster of Paris
17. Super Shelcem
18. Silos
19. Volumetric analysis
20. Preparation of slurry
21. Silicon dioxide, Aluminium oxide (Alumina) and Ferric oxide
22. Grinding of raw materials
23. Rotary Kiln
24. CaSO₄. ½ H₂O
25. Carbondioxide

**APPENDIX H
OBSERVATION SCHEDULE**

Name of student : _____

PART I

I	Performance skills	Excellent	Very good	Good	Satisfactory	Unsatisfactory
	i) Observation skill					
	ii) Manipulative skill					
	iii) Acquisitive skill					
	iv) Skill of experimentation					
	v) Communicative skill					
	vi) Creative skill					
	vii) Skill of computing equations					

Remarks:

PART II

II	Recording of activities					
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Remarks:

PART III

	Items	Excellent	Very good	Good	Satisfactory	Unsatisfactory
1.	Student involvement in learning					
2.	Pacing of student in the activity					
3	Co-operation with the staff					
4	Co-operation with the fellow students in the group					
5	Discipline maintained					

Remarks:

PART IV

Consolidation of observations:

APPENDIX I

Lessons for Direct instruction (DI)

I. Content Overview.

Major topic: Preparation and properties of Cement.

Subtopics:

1. Cement Industry in India.
2. Types and compositions of cement.
3. Manufacture and properties of cement.
4. Manufacture and properties of Lime.
5. Preparation and properties of Plaster of Paris.
6. Preparation and properties of metallic Calcium.

II. Learning Objectives.

The objectives of instruction are given in detail in the Unit Plan.

III. Facts, Concepts and processes.

Pupils learn the following facts and concepts and processes:

1. Modern cement known as Portland cement, was patented by Joseph Aspdin, a Leeds builder.
2. Portland cement or ordinary cement is normal setting cement.
3. After setting, the cement closely resembles a variety of sand stone which is found in abundance in Portland in England and so it is known as Portland cement.
4. Raw materials used for the preparation of cement are Lime, Silica, Alumina & Iron oxide.
5. Portland cement is obtained by intimately mixing together calcereous and argillaceous, or other silica- alumina and iron oxide bearing materials.

6. Calcerous materials in cement - limestone or chalk and argillaceous materials include silica and alumina found as clay or shala
7. Cement is obtained by burning the raw materials in a kiln at a clinkering temperature and grinding the resulting clinker.
8. The addition of gypsum in cement is to increase its setting properties.
9. Manufacturing process of cement includes the following processes.
 - i) Grinding the raw materials into a very fine powder – in a dry condition (dry process) or in water (wet process)
 - ii) Mixing them intimately in predetermined proportion.
 - iii) Burning in a large rotary kiln at a temperature of about 1400°C, particularly fusing into clinker.
 - iv) Cooling the clinker and grinding to a fine powder with some gypsum.
10. Procedure adopted for the production of cement.

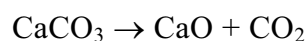
Inside the Rotary Kiln, slightly inclined, the mixture of raw materials is fed at the upper end while pulverized coal is blown in the form of an air blast at the lower end of the kiln where the temperature may reach about 1500°C.

[Coal – source of heat]

As the mixture of raw materials moves down to Kiln, it encounters a progressively higher temperature so that various chemical changes take place along the Kiln.

The reactions are:

1. Water is driven off and CO₂ is liberated from the Calcium Carbonate



2. The dry material undergoes a series of chemical reactions to form clinker.
3. The clinker drops into coolers which provide means for an exchange of heat with the air subsequently used for the combustion of the pulverized coal.
4. The cool clinker, which is very hard, is inter ground with gypsum to get cement

Points to note: The grinding with gypsum is in order to prevent flash-setting of the cement, the amount of gypsum added depends upon the Tricalcium aluminate content and the alkali content of the cement.

The optimum gypsum content is determined on the basis of the generation of the heat of hydration.

[The quantity of heat (in joules) per gram of unhydrated cement, evolved upon complete hydration at a given temperature is defined as the heat of hydration.]

IV. Learning Experiences.

The teacher presents the topics in small steps starting from giving a general introduction about cement production in India and the cement industries in Kerala. Pupils cite examples for common brands on cement available in the market.

Pupils discuss the common properties of cement which are familiar to them like colour, common uses etc. pupils are familiar with the properties of cement when mixed with sand and water. The teacher takes it as a base to develop the scientific concepts involved in these reactions.

The teacher presents examples for different types of cement and pupils discuss the qualities of the various types with the help of teacher.

Pupils identify the raw materials required for the manufacturing of cement. They identify the chemical name, formulae and common physical and chemical properties. During discussion, teacher explains additional points and examples relevant to the topic. Pupils engage conducting experiments to learn the chemical reactions.

Teacher explains, with the help of charts and diagrams, the stages and processes involved in the manufacture of cement. The concepts are developed through discussion, questions and answers, citing examples, computing equations of chemical reactions and giving narrated demonstrations of the learned task by the students. The teacher presents the material in small, integrated steps, rectifying errors of students by providing more examples and illustrations and motivates the students to stay on the topic. Difficult areas are located and re-explained using additional points and examples.

Formative evaluation of learning is done through asking probing questions and eliciting answers, giving topics for discussion and preparation of notes etc., until the mastery on the content is achieved.

V. Evaluation

A summative evaluation of learning is carried out at the end of the lessons, using an achievement test prepared based on specific objectives.