



GEOPOLYMER COARSE AGGREGATE (GPCA)

User should check the validity of the Certificate by contacting Member Secretary, BMBA at BMTPC or the Holder of the Certificate

Name and Address of Certificate Holder: **NTPC LTD**,
NTPC Bhawan
Scope Complex Institutional Area,
Lodhi Road,
New Delhi – 110003
Website: www.ntpc.co.in

Performance Appraisal Certificate
PAC No. **1063-M/2023**
Issue No. **01**
Date of Issue: **22.06.2023**



bmtpc


**Building Materials & Technology Promotion Council
Ministry of Housing & Urban Affairs
Govt. of India**

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Performance Appraisal Certificate
For
Geopolymer Coarse Aggregate (GPCA)
Issued to
M/s NTPC LTD

STATUS OF PAC

S. No.	Issue No.	Date of Issue	Date of Renewal	Amendment		Valid upto (Date)	Remarks	Signature of Authorized Signatory
				No.	Date			
1	01	22.06.2023				21.06.2024		

PAC No. 1063-M/2023

Issue No. 01

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PART 1: CERTIFICATION

1.1 Certificate Holder: NTPC LTD, NTPC Bhawan
Scope Complex Institutional Area
Lodhi Road, New Delhi – 110003
Web Site: www.ntpc.co.in

Manufacturing Facility:
NTPC Sipat, Bilaspur, Chattisgarh

1.2 Description of Product

1.2.1 Name of the Product: Geopolymer Coarse Aggregate (GPCA)

1.2.2 Proprietary Name/Brand Name/Trade Name/Trademark: Geopolymer Coarse Aggregate (GPCA)

1.2.3 Brief Description

The Geopolymer Coarse Aggregate (GPCA) has been developed by NTPC by primarily utilizing Fly Ash, an Industrial by-product, from coal based Thermal Power Plants (TPPs). The initial production & lab scale research work on these aggregates were conducted at NTPC Ramagundam. Apart from fly ash from ESP 2nd field onwards from coal based TPPs, the other main ingredients for making GPCA include Sodium Hydroxide (NaOH) flakes, sodium silicate (Na₂SiO₃) liquid and water. The designed proportions of all the raw materials are thoroughly mixed & transferred to roller compressed machine to produce aggregates.

After the trial production, a pilot project of 20MT/Day capacity has been installed at NTPC Sipat to manufacture GPCA for its various applications as alternate to natural stone aggregate. The use of this aggregate can help in sustainable development of construction industry through use of Industrial by-product with proportionate conservation of natural stone aggregate resources.

1.3 Assessment

1.3.1 Scope of Assessment

The scope of assessment included suitability of Geopolymer Coarse Aggregate (GPCA) in the preparation of Cement Concrete upto Concrete Grade M30 as replacement of natural stone aggregate. The use of GPCA shall be as per Concrete Mix Design.

1.3.2 Basis of Assessment

The assessment of the product is based on the followings;

- i. The Testing & Evaluation Report of the manufactured coarse Aggregate of 20 mm size by National Council for Cement and Building Materials (NCCBM), Hyderabad (November, 2020). The GPCA (coarse Aggregate of 20 mm size) was manufactured & supplied by NTPC, Ramagundam.
- ii. Quality Assurance Plan adopted by PAC Holder.
- iii. The visit of the Manufacturing Facility at NTPC, Sipat & Interaction with concerned NTPC Officials through Video conferencing on March 02, 2023.

1.4 Uses of Geopolymer Coarse Aggregate (GPCA)

1.4.1 Uses of the Product

The product can be used as replacement of natural stone aggregate (NSA) in following ways;

- i. In Plain & Reinforced concrete components of the building
- ii. Pre-cast concrete components such as Interlocking Paver Blocks, Wall panels, etc.
- iii. Road construction & repair works, and use in sub-base course in road works
- iv. It results in reduction of dead load of concrete structure. Handling of material is easy due to its lower bulk density.

1.4.2 Special Aspects of Use/Limitations;

- i. The Concrete Mix Designer & user Agencies shall gain full familiarity with various properties of the product.
- ii. Geopolymer Coarse Aggregates have shown good results in terms of impact & abrasion resistance. However, this being new product, the long term studies are required to assess it further.
- iii. GPCA has relatively higher water absorption than natural stone aggregate. Hence wetting the aggregate (to achieve saturated surface dry condition) is necessary before producing concrete with it at construction site.
- iv. As the water absorption of the aggregate is high, it needs to be ensured that water used during its manufacturing, curing process and use at construction site is potable, and the amount of chloride content is within permissible limits (as per IS 456: 2000).

1.5 Conditions of Certification

1.5.1 Technical Conditions

- i. Technical Specifications- Raw materials and the finished product shall conform to the requirements of prescribed specifications.

- ii. The Certificate Holder shall provide all required technical details for application of this product to user agencies.
- iii. Quality Assurance- The Certificate holder shall maintain a quality assurance system in accordance with Quality Assurance Plan.

1.5.2 Handling of User Complaints

The Certificate holder shall provide quick redressal to consumer/user complaints which proved reasonable & genuine and within the conditions of warranty provided by it to customer/ purchaser.

As part of PACS Certification, it shall maintain data on such complaints with a view to assess the complaint redressal & suitable preventive measures taken.

1.6 Certification

On the basis of assessment given in Part-3 of this Certificate & subject to the conditions of Certification, use & limitations set out in this Certificate and if selected, used & maintained as set out in Part 1 & Part-2 of this Certificate, Geopolymer Coarse Aggregate (GPCA) is fit for use set out in the Scope of Assessment.

PART 2: CERTIFICATE HOLDER'S TECHNICAL SPECIFICATIONS

2.1 General

The PAC holder shall manufacturer the GPCA in accordance with the requirements specified in relevant IS Standards and other codal provisions. In addition, it shall follow its own standards specifying requirements of various materials used in the manufacturing of the product.

2.2 Technical specification for Raw Materials

The manufacturer shall only use the raw materials supplied with the relevant documents/prescribed Quality Assurance Plan. The raw materials shall be subject to agreed controls and tests by the manufacturer before acceptance.

Table 1 List of Raw Materials & Technical Specifications

S. No.	Raw material/ component	Source	Specification	If quality certified in any form, state
1.	fly ash	NTPC Sipat	IS 3812 (Part I) - 2013	In-house test certificate
2.	Sodium Hydroxide	Any	IS 376-1986 (Reaffirmed 2010)	MTC
3.	Sodium Silicate	Any	IS 381-1995 (Reaffirmed 1999)	MTC
4.	Water	Any	IS 456-2000	MTC

2.2.2 Performance requirements of the product

Table 2 Performance requirements of the product

S. No.	Description of the test parameter	Limits as per IS 9142 (Part 2): 2018
1.	Specific Gravity (with 20mm size manufactured aggregate) tested as per IS 2386 (Part III)	-
2.	Water Absorption (with 20mm size manufactured aggregate) tested as per IS 2386 (Part III)& IS 9142 (Part 2):2018	18.0% (max)
3.	Bulk Density (Loose) (with 20mm size manufactured aggregate) tested as per IS 2386 (Part III)& IS 9142 (Part 2):2018	950 ($\pm 10\%$) kg/m ³

S. No.	Description of the test parameter	Limits as per IS 9142 (Part 2): 2018
4.	Combined Flakiness & Elongation index (Total material 20mm Coarse aggregate used) Tested as per IS 2386 (Part I) a. Flakiness index = 0% b. Elongation index = 0%	As per IS 383: 2016 40% (max)
5.	Abrasion Value Test using Los Angeles's abrasion machine (Tested with 20mm size manufactured Coarse aggregate used) Tested as per IS 2386 (Part IV) & IS 9142 (Part 2): 2018	40% (max)
6.	Soundness Test On 20mm coarse aggregate using saturated sodium sulphate (Na ₂ SO ₃) tested for average loss of weight after 5 cycles tested as per IS 2386 (Part IV) & IS 9142 (Part 2): 2018	12.0% (max)
7.	Crushing Value Tested on broken coarse aggregate material passing through 12.5mm sieve and retained on 10mm sieve tested as per IS 2386 (Part IV) & IS 9142 (Part 2): 2018	45% (max)
8.	Impact Value Tested on broken coarse aggregate material passing through 12.5mm sieve and retained on 10mm sieve tested as per IS 2386 (Part IV) & IS 9142 (Part-2): 2018	40% (max)

2.3 Special features of the product

- Geopolymer coarse aggregates are artificial aggregates made from industrial waste as fly ash.
- The aggregate is light in weight and meet the specifications to be used in concrete works.
- Being light in weight material handling is easy compared to natural stone aggregate.
- Self-weight of RCC structures will reduce with the usage of GPCA, resulting in the reduction in cost of construction.
- No need of any stone quarrying required for the production of GPCA, conserving the already scarce natural resource.
- Manufacturing of GPCA does not require water for curing.

2.4 Manufacturing Process

i. Material selection:

Fly ash (Dry fly ash from thermal power plants ESP 2nd field onwards material is to be selected for best results), Sodium Hydroxide (NaOH) Flakes, Sodium Silicate (Na₂SiO₃) liquid & water as per the specifications defined in the technical specification of Raw Materials above.

ii. Equipment:

- a. Silo
- b. Screw conveyor
- c. Belt conveyor
- d. Pan mixer
- e. Roller compressor machine

iii. Solution Preparation:

Designed proportions of Sodium Hydroxide (NaOH), Sodium Silicate (Na₂SiO₃) and water are prepared 12 hours prior to its usage in the mix. The temperature of the solution shoots up as soon as chemicals are mixed. Thorough safety precautions need to be taken while handling chemicals like wearing goggles, hand gloves etc.

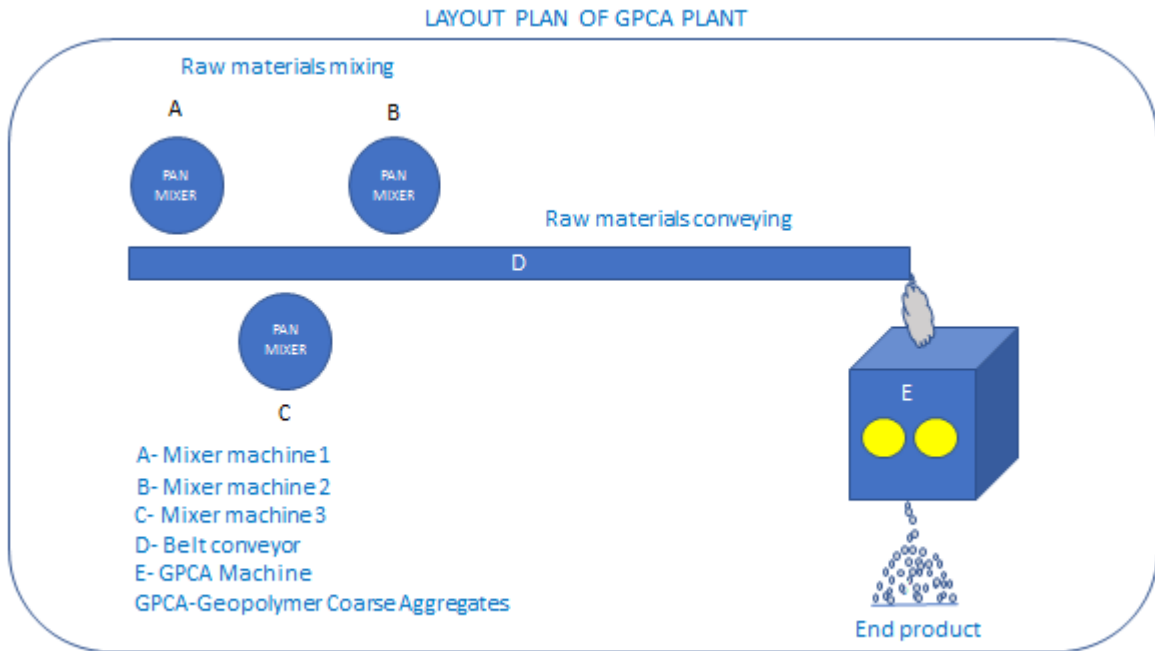
iv. Production Process:

- a. Designed quantities of Fly ash & chemical solution are mixed thoroughly in Pan mixer. All the materials from pan mixer are conveyed through belt conveyor to roller compacted aggregate making machine.
- b. Roller compressed machine will compress the material to the designed shape and size and discharged material is taken to curing process.
- c. Curing process;

Option 1: No need of water curing. Product is exposed to natural sunlight for a period of one week to get full strength. Duration of curing depends on atmospheric temperature of particular location. High temperature geographic conditions suit to this type of curing.

Option 2: Heat curing is to be done. It is required in cold weather conditions. After one day of natural curing, all the aggregates are to be kept in heating chamber wherein aggregates are exposed to a temperature of 70°C for a period of 12 hours

2.4.1 Flow Chart of Manufacturing Plant:



2.4.2 Manufacturing Machinery

Table 3

S. No.	Name of Machine	Name of Model	Make	Capacity	Power Required	No. of machines	Remarks
1.	Roller Compression machine	Model: RPD L	Sree Engineering works, Hyderabad	2.5 MT/Hour	20 HP (each)	1	
2.	Pan Mixer	MXA -01	Sree Engineering works, Hyderabad	62.5 Kg/Hour	10 HP (each)	3	
3.	Belt Conveyor	NA	Sree Engineering works, Hyderabad	-	2 HP (each)	2	

Table 4

Maintenance Schedule		
S. No.	Description	Frequency
1	Conveyors	
	Belt	
	Belt-Cuts, damages, cracks	Daily
	Cleaning of material spillage	Daily
	Motor-External cleaning	Daily
	Belt-Slippage check	Weekly
	System Lubrication	Weekly
	Motor-Earth connections check	Weekly
	Belt-Tension	Monthly
	Belt-Lacing	Monthly
	Motor-Temperature & vibration check	Monthly
2	Pan mixers	
	Emptiness of PAN mixer check	Daily
	Motor-External cleaning	Daily
	Clearance check of scraper with floor and wall of mixer	Weekly
	Motor-Earth connections check	Weekly
	Motor-Temperature & vibration check	Monthly
	Lubrication of is charge gate	Monthly
3	Roller Compressor machine	
	Cleaning of material spillage	Daily
	Motor-External cleaning	Daily
	Check for alignment of rollers	Weekly
	Lubrication of system	Weekly
	Motor-Earth connections check	Weekly
	Motor-Temperature & vibration check	Monthly
	Gear box Oil level check	Monthly

2.5 Method of handling of the product at site

It is to be handled in the same manner as Natural stone aggregate, no special care as such is required.

2.6 Inspections & Testing

Inspections & testing shall be done at appropriate stages of manufacturing process. As part of quality assurance, regular in-process inspections shall be carried out by the trained personnel of the PAC holder.

2.7 Guarantees/ Warranties provided by the PAC holder to the customer

The PAC Holder shall provide necessary guarantees/ warranties. A brochure giving relevant details of the Aggregate shall be made available to the user.

2.8 Responsibility

Specific performance of the product is the responsibility of the user Agency/ Concrete Mix Designer, as per the requirement of the Agency with guidance of the PAC holder.

PART 3: BASIS OF ASSESSMENT & BRIEF DESCRIPTION OF ASSESSMENT PROCEDURE

3.1 Assessment

3.1.1 The assessment has been done as per the provisions of the standards listed in Part-5 of this Certificate.

3.1.2 Various tests for assessment of physical properties of GPCA, carried out in NCCBM test lab, Hyderabad (November, 2020). The Test report is as per the details below;

Table 5

S. No.	Description of the test parameter	Results obtained	Limits as per IS 9142 (Part 2): 2018
1.	Specific Gravity (with 20mm size manufactured aggregate) tested as per IS 2386 (Part III)	1.32	-
2.	Water Absorption (with 20mm size manufactured aggregate) tested as per IS 2386 (Part III)& IS 9142 (Part 2):2018	13.2%	18.0% (max)
3.	Bulk Density (Loose) (with 20mm size manufactured aggregate) tested as per IS 2386 (Part III)& IS 9142 (Part 2):2018	970 kg/m ³	950 (±10%) kg/m ³ (Max)
4.	Combined Flakiness & Elongation index (total material 20mm Coarse aggregate used) Tested as per IS 2386 (Part I) a. Flakiness index = 0% b. Elongation index = 0%	0%	As per IS 383: 2016 40% (max)
5.	Abrasion Value Test using Los Angele's abrasion machine (Tested with 20mm size manufactured Coarse aggregate used) Tested as per IS 2386 (Part IV) & IS 9142 (Part 2): 2018	22.0%	40% (max)
6.	Soundness Test on 20mm coarse aggregate using saturated sodium sulphate (Na ₂ SO ₃) tested for average loss of weight after 5 cycles tested as per IS 2386 (Part IV)& IS 9142 (Part 2):2018	13.9%	12.0% (max)
7.	Crushing Value Tested on broken coarse aggregate material passing through 12.5mm sieve and retained on 10mm sieve tested as per IS 2386 (Part IV) & IS 9142 (Part 2): 2018	35.82%	45% (max)
8.	Impact Value Tested on broken coarse aggregate material passing through 12.5mm sieve and retained on 10mm sieve tested as per IS 2386 (Part IV) & IS 9142 (Part-2): 2018	19.15%	40% (max)

3.1.3 Quality Assurance system followed by the Certificate holder is at **Annexure 1**.

3.1.4 Product Data sheet prepared by the Agency, enclosed at **Annexure 2**.

3.1.5 The GPCA is in production since May 2020 and a two-room building was constructed at NTPC Ramagundam in November, 2021. The basic tests were carried out in house at NTPC quality lab & further for its physical & chemical properties at NCCBM as per details above. The Agency has been further advised to go for reputed Third Party assessment of the Strength, structural / mechanical properties, & durability of the concrete made with GPCA, as these tests have not been carried out by the Agency from Third Party Laboratory presently. The Agency has agreed for the same.

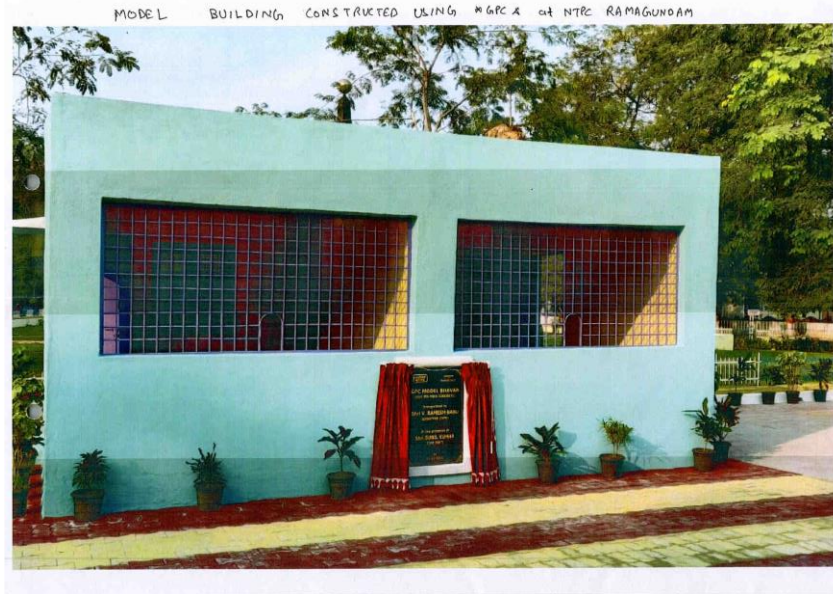
3.2 Site Inspection

The setup of the Agency was visited/inspected by the members of TAC & Officers of BMTPC via video conferencing on March 02, 2023 & interaction were held with technical personnel of the Agency. The agency presented/ demonstrated the entire production process, testing results, quality assurance mechanisms, etc.

3.3 Usage of the Product

Applications of GPCA

- i. Aggregates were used for making concrete in May, 2020 with design mix developed at Geopolymer laboratory, NTPC Ramagundam. The performance of the product has been satisfactory and needed no maintenance.
- ii. This product is being used as replacement of natural aggregate at NTPC Ramagundam & Sipat. A two-room building was constructed at NTPC, Ramagundam in November, 2021 and the building is in service without any maintenance requirement.
- iii. This aggregate was also used in concrete for road repair works at NTPC, Ramagundam.
- iv. Interlocking paver blocks are under production at NTPC Ramagundam & Sipat.



**Model building constructed using GPCA
at NTPC Ramagundam**

PART 4: STANDARD CONDITIONS

This certificate holder shall satisfy the following conditions:

- 1 The certificate holder shall continue to have the product reviewed by BMBA.
- 2 The product shall be continued to be manufactured according to and in compliance with the manufacturing specifications and quality assurance measures which applied at the time of issue or revalidation of this certificate. The Scheme of Quality Assurance separately approved shall be followed.
- 3 The quality of the product shall be maintained by the certificate holder.
- 4 The product user should install, use and maintain the product in accordance with the provisions in this Certificate.
- 5 This certificate does not cover uses of the product outside the scope of this appraisal.
- 6 The product is appraised against performance provisions contained in the standards listed in Part-5. Provisions of any subsequent revisions or provisions introduced after the date of the certificate do not apply.
- 7 Where reference is made in this Certificate to any Act of Parliament of India, Rules and Regulations made there under, statutes, specifications, codes of practice, standards etc. of the Bureau of Indian Standards or any other national standards body and the International Organization for Standardization (ISO), manufacturer's company standards, instruction/manual etc., it shall be construed as reference to such publications in the form in which they were in force on the date of grant of this Certificate (and indicated in Part 5 to this Certificate)
- 8 The certificate holder agrees to inform BMBA of their distributors / licensees whenever appointed by him and agrees to provide to BMBA a six monthly updated list thereof.
- 9 The certificate holder agrees to provide to BMBA feedback on the complaints received, the redressal provided, and the time taken to provide redressal on complaint to complaint basis as soon as redressal is provided. BMBA agrees to provide the certificate holder the user feedback received by it, if any.
- 10 If at any time during the validity period, PAC is unable to fulfill the conditions in his PAC, he should on his own initiative suspend using the PAC and notify Chairman, TAC the date from which he has suspended its use, the reason for suspension and the period by which he will be able to resume. He shall not resume without the prior permission of BMBA. He shall also inform, simultaneously, his agents, licensees, distributors, institutional, government, public sector buyers, other buyers and all those whom he has informed about his holding the PAC. He shall also inform all those who buy his product(s) during the period of suspension. He shall provide to BMBA at the earliest the list of who have been so informed by him.
- 11 In granting this Certificate, BMBA takes no position as to:
 - (a) The presence or absence of patent or similar rights relating to the product;
 - (b) The legal right of the Certificate holder to market, install or maintain the product;
 - (c) The nature of individual installations of the product, including methods of workmanship.

- 12 BMTPC and the Board of Agreement of BMTPC (BMBA) take no position relating to the holder of the Performance Appraisal Certificate (PACH) and the users of the Performance Appraisal Certificate (PAC) respecting the patent rights / copy rights asserted relating to the product / system / design / method of installation etc. covered by this PAC. Considerations relating to patent / copy rights are beyond the scope of the Performance Appraisal Certification Scheme (PACS) under which this PAC has been issued. PACH and users of this PAC are expressly advised that determination of the Claim / validity of any such patent rights / copy rights and the risk of infringement of such rights are entirely the responsibility of PACH on the one hand and that of the users on the other.
- 13 It should be noted that any recommendations relating to the safe use of the product which are contained or referred to in this Certificate are the minimum standards required to be met with when the product is installed, used and maintained. They do not purport in any way to restate or cover all the requirements of related Acts such as the Factory Act, or of any other statutory or Common Law duties of care, or of any duty of care which exist at the date of this Certificate or in the future, nor is conformity with the provisions of this Certificate to be taken as satisfying the requirements of related Acts.
- 14 In granting this Certificate, BMTPC and BMBA does not accept responsibility to any person or body for any loss or damage, including personal injury, arising as a direct or indirect result of the use of this product.
- 15 The certificate holder indemnifies BMBA, its officers and officials involved in this assessment against any consequences of actions taken in good faith including contents of this certificate. The responsibility fully rests with the certificate holder and user of the product.
- 16 The responsibility for conformity to conditions specified in this PAC lies with the manufacturer who is granted this PAC. The Board (BMBA) will only consider requests for modification or withdrawal of the PAC.
- 17 The PAC holder shall not use this certificate for legal defense in cases against him or for legal claims he may make from others.



Place: New Delhi
Date of issue: 22/06/2023

Chairman TAC & for and on behalf of Member
Secretary, BMBA

PART 5: LIST OF APPLICABLE STANDARDS AND CODE

- 5.1 **Standards:** These standards are referred for carrying out particular tests only & do not specify the requirement for the whole product as such.
- 5.1.1 IS 9142 (Part 2) – 2018, Artificial lightweight aggregate for concrete – Sintered fly ash coarse aggregate
 - 5.1.2 IS 383 – 2016, Coarse and Fine Aggregate for Concrete – Specification (Third Revision)
 - 5.1.3 IS 3812 (Part I) -2013- Pulverized fuel ash flyash part I – for use as pozzolana in cement, mortar, concrete.
 - 5.1.4 IS 376-1986 (Reaffirmed 2010) - Specification for Sodium Hydroxide analytical reagent
 - 5.1.5 IS 381-1995 (Reaffirmed 1999) - Sodium silicate specification
 - 5.1.6 IS 456-2000 – Code of practice for plain and reinforced concrete
- 5.2 **Company Standards of PAC Holder** – The PAC Holder has to make available the Company Standards to the consumers according to which testing has been done.

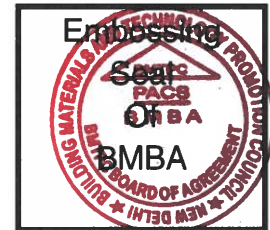
CERTIFICATION

In the opinion of Building Materials & Technology Promotion Council's Board of Agreement (BMBA), **Geopolymer Coarse Aggregate (GPCA)** is satisfactory if used as set out above in the text of the Certificate. This Certificate **PAC No. 1063-M/2023** is awarded to **M/s NTPC Ltd., New Delhi.**

The period of validity of this Certificate is for a period of one year i.e. from **22/06/2023 to 21/06/2024** as shown on Page 1 of this PAC. This Certificate consists of pages 1 to 23.



Dr. Shailesh Kr. Agrawal
Chairman, TAC
& Member Secretary, BMBA
Building Materials and Technology Promotion Council
Ministry of Housing and Urban Affairs, Govt. of India
Core 5A, 1st Floor, India Habitat Centre
Lodhi Road, New Delhi-110003



On behalf of BMTPC Board of Agreement Chairman, Technical Assessment Committee (TAC) of BMBA & Member Secretary, BMTPC Board of Agreement (BMBA) Under Ministry of Housing and Urban Affairs, Government of India

Place: New Delhi, India
Date: 22/06/2023

PART 6: LIST OF ABBREVIATIONS

BMBA	Board of Agreement of BMTPC
BMTPC	Building Materials and Technology Promotion Council
CPWD	Central Public Works Department
ED	Executive Director of BMTPC
IO	Inspecting Officer
MS	Member Secretary of BMBA
PAC	Performance Appraisal Certificate
PACH	PAC Holder
PACS	Performance Appraisal Certification Scheme
SQA	Scheme of Quality Assurance
TAC	Technical Assessment Committee (of BMBA)

PERFORMANCE APPRAISAL CERTIFICATION SCHEME – A BRIEF

Building Materials & Technology Promotion Council (BMTPC) was set up by the Government of India as a body under the Ministry of Housing & Urban Poverty Alleviation to serve as an apex body to provide inter-disciplinary platform to promote development and use of innovative building materials and technologies laying special emphasis on sustainable growth, environmental friendliness and protection, use of industrial, agricultural, mining and mineral wastes, cost saving, energy saving etc. without diminishing needs of safety, durability and comfort to the occupants of buildings using newly developed materials and technologies.

During the years Government, public and private sector organizations independently or under the aegis of BMTPC have developed several new materials and technologies. With liberalization of the economy several such materials and technologies are being imported.

However, benefits of such developments have not been realized in full measure, as understandably the ultimate users are reluctant to put them to full use for want of information and data to enable them to make informed choice.

In order to help the user in this regard and derive the envisaged social and economic benefits the Ministry of Housing & Urban Poverty Alleviation instituted a scheme called Performance Appraisal Certification Scheme (PACS) under which a Performance Appraisal Certificate (PAC) is issued covering new materials and technologies. PAC provides after due investigation, tests and assessments, amongst other things information to the user to make informed choice.

To make the PACS transparent and authentic it is administered through a Technical Assessment Committee (TAC) and the BMTPC Board of Agreement (BMBA) in which scientific, technological, academic, professional organizations and industry interests are represented.

The Government of India has vested the authority for the operation of the Scheme with BMTPC through Gazette Notification No. 1-16011/5/99 H-II in the Gazette of India No. 49 dated 4th December, 1999.

Builders and construction agencies in the Government, public and private sectors can help serve the economic, development and environmental causes for which the people and Government stand committed by giving preference to materials and technologies which have earned Performance Appraisal Certificates.

Further information on PACS can be obtained from the website: www.bmtpc.org

Annexure-1

Quality Assurance Plan

i. Quality Assurance Plan for Raw materials;

S. No.	Raw material/ component	Testing Frequency	Specification	Reporting Method
1.	Fly ash	Each Batch/lot	IS 3812 (Part I) - 2013	In-house test certificate
2.	Sodium Hydroxide	Each Batch/lot	IS 376-1986 (Reaffirmed 2010)	MTC
3.	Sodium Silicate	Each Batch/lot	IS 381-1995 (Reaffirmed 1999)	MTC
4.	Water	For each change of source	IS 456-2000	In-house test certificate

ii. Quality Assurance Plan for Geopolymer coarse aggregate is to adopted as per the details below;

S. No.	Performance Characteristics	Requirement, with tolerance, if any	Test Method	Frequency	
				In house	External NABL Accredited lab
1	Aggregates Impact Value %	40 Max	IS: 2386 Part-4 (1963)p (Reaffirmed : 2021)	Each Batch	Every six months
2	Aggregates Crushing Value %	45 Max		Each Batch	Every six months
3	Aggregates abrasion value %	40 Max		Each Batch	Every six months
4	Specific Gravity	1.2 to 1.8	IS: 2386 Part-3 (1963)	Each Batch	Every six months
5	Water Absorption %	18 Max	(Reaffirmed : 2021)	Each Batch	Every six months

Annexure-2

Product Data Sheet
Edition 1, 2021

Geopolymer Coarse Aggregates (GPCA)

Product Details

GPCA is lightweight flyash based manufactured coarse aggregate produced by mixing fly ash in the alkaline activator solution consisting of sodium hydroxide and sodium silicate. The so produced GPCA are tested for different physical properties and confirm to relevant IS code standards. Owing to the lower specific gravity of GPCA, its consumption is also lower in concrete leading to reduced overall cost of concreting.

Salient Features

Following are the salient features of GPCA:

- ❖ Promotes usage of waste materials like fly ash.
- ❖ Can be used as 100% replacement to conventional natural stone aggregates in concrete works.
- ❖ Very low soundness and alkali aggregate reaction.
- ❖ Acceptable water absorption of GPCA.
- ❖ Environment friendly alternative as it reduces the sound and dust pollution and reduces mining of natural stone.
- ❖ Improves the long-term durability of the concrete.
- ❖ Normal set without retardation, even when overdosed.
- ❖ Promotes strength gain in concrete.
- ❖ Reduced overall cost of concreting.

Recommended Uses

GPCA can be used as 100% replacement to conventional natural stone aggregates for following works:

- ❖ RCC works up to M40
- ❖ Road Work-- PQC & DLC
- ❖ Precast Concrete Components
- ❖ Land reclamation
- ❖ Back filling material
- ❖ Overburden for mine filling
- ❖ Dams & other irrigation works
- ❖ Pavers and Bricks

Dosages

The dosage of GPCA is similar to that of natural stone aggregates in concrete/ mortar works. However, the same is decided as per the volume. Owing to the lower specific weight, the actual weight of GPCA is comparatively lower than that of natural stone in the mix.

Properties & Handling Precautions

- | | |
|-------------------------|-------------------------------------|
| • Type | - Granules |
| • Color | - Grey |
| • Specific Gravity | - 1.32 – 2.0 |
| • pH | - 9.5 – 12 |
| • Mechanical properties | - Complies with IS 9142(p2): 2018 |
| • Shelf Life | - 1 year from date of manufacturing |
| • Packaging | - Truck load |

GPCA is generally quite harmless, provided certain precautions are taken for handling. Wear protective clothing, gloves, shoes, glass etc. In the event of contamination, wash thoroughly with water. If the eye or mouth is affected, wash with clean water and obtain medical attention.

Important Note

The technical information and application advice given in this data sheet is based on the present state of our experience and is correct to the best of our knowledge. However, since success in the application of our products is dependent on number of factors, we can only be responsible for quality of our products at the time of our dispatch. Certain changes are possible in the product data sheet as we are constantly endeavoring to improve it through our R&D. Hence, in the event of any doubt on critical parameter, it is advisable to seek clarification from our technical personnel.

Safety Precautions

