

E. Carbonated Brick (C-Brick) Manufacturing Block

E.1 Plant Capacity & Design Considerations:

1	C-Brick Manufacturing Capacity	2,00,000 Nos/Day (Minimum)
2	CO2 Mineralization	<ul style="list-style-type: none"> i) CO2 Fixation Quantity: > 5 % (Weight), ii) CO2 Fixation Stage: 2-Stage, iii) Stage-1 Details: (Carbonation Reactor) <ul style="list-style-type: none"> o Process: Chemical, o CO2 Pressure: ~6-10 Bar, o CO2 Temperature: Ambient, o Holding Time: 30 Minutes (to be fine-tuned during plant commissioning) iv) Stage-2 Details: (CO2 Autoclave) <ul style="list-style-type: none"> o Process: Physicochemical, o CO2 Pressure: ~6-10 Bar, o CO2 Temperature: Ambient, o Holding Time: 60 Minutes (to be fine-tuned during plant commissioning)
3	Autoclave Steam Curing	<ul style="list-style-type: none"> i) Steam Parameter: 10-12 Bar (saturated), ii) Holding Time: 12 Hour (to be fine-tuned during plant commissioning)
4	Hydraulic Brick Press	<ul style="list-style-type: none"> i) Pressing Capacity: 50 Ton on each brick (on 230x110 mm side) ii) Brick Size: 230x110x75 mm (for tender purpose, to be finalized at the stage of detailed engineering)

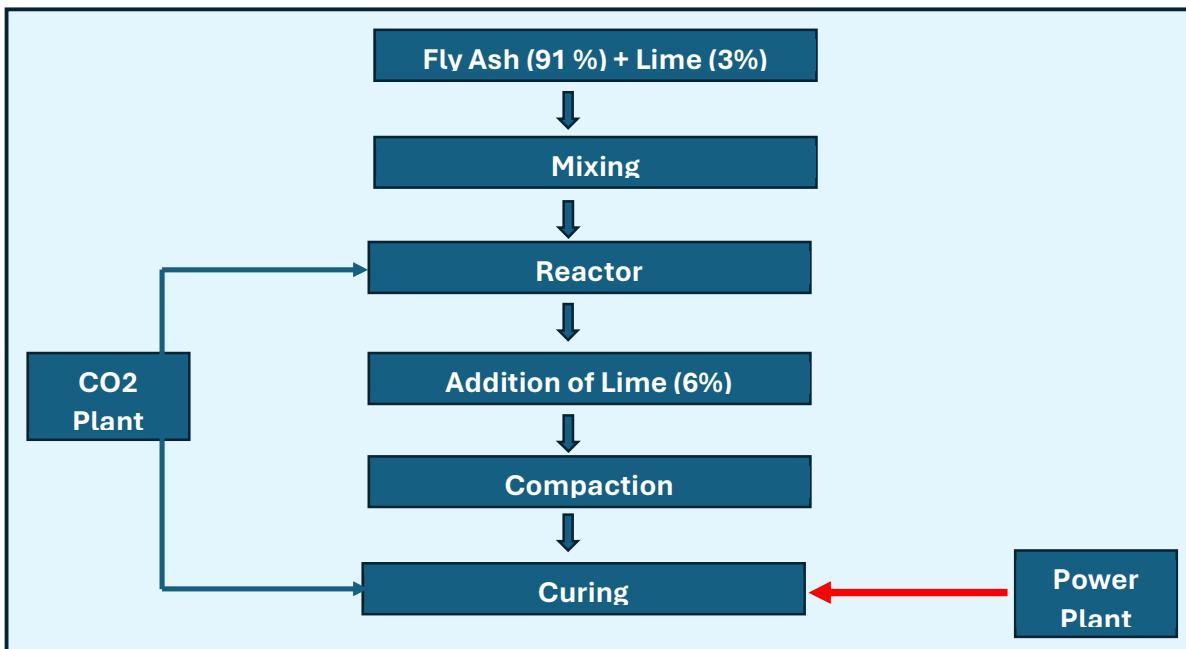
E.2. Process Description

E.2.1. Process Elements:

Production of ‘Carbonated Brick (C-Brick)’ shall, typically, comprise of following steps. All the quantitative figures mentioned herein (composition, time etc) are indicative and shall be finetuned during the course of plant commissioning.

- i) Mix proportion of 91% fly ash + 03% lime in Sun and Planetary mixer.

- ii) Addition of 11% water to the dry mix of Fly ash and Lime in Sun & Planetary Mixer. Total mixing time envisaged is ~4 minutes/batch.
- iii) Transfer the mix to a ‘Carbonation Reactor’, followed by CO₂ charging and holding it for 30 minutes/batch at 6-10 bars to facilitate ‘CO₂ Mineralization’,
- iv) Transfer the partially carbonated mix to Attrition Mixer and add 6% Lime afresh with 4% additional water,
- v) Hydraulic Brick Pressing using 50 Ton load on each Green Brick (on 230x110 mm side of the brick),
- vi) Green Brick Precuring in Steam Chamber (2-3 bar) for ~6 hours/batch,
- vii) Steam Autoclave Curing: Steam curing at the peak parameters (steam pressure: 12.5 kg/cm², steam temperature: 190±5 °C) for ~6 hours (excluding the time for heating and cooling). Total time envisaged in Steam Autoclave is ~12 hours/batch.
- viii) Transfer of steam autoclaved brick to CO₂ autoclave.
- ix) CO₂ Autoclave Curing: CO₂ curing at 6-10 bar for at least 1 hour – excluding the time needed for charging and discharging of brick and CO₂.
- x) There will be provision for (i) safe venting of residual CO₂ from all ‘CO₂ Autoclave’ and ‘Carbonation Reactor’, (ii) reuse of residual CO₂ from all ‘CO₂ Autoclave’ and ‘Carbonation Reactor’. Appropriate arrangement alongside pipework and remote operated valves shall be provided towards the aforesaid.



E.2.2. Process Description:

a) Storage of raw materials, automated batch weighing & feeding system:

The system shall include Storage Silos, VFD screw feeders, Load Cells, Weigh Batchers, Associated Conveyors, Interconnecting chutes etc. The unloading system shall be pneumatic for dry powdery materials like fly ash & lime. The raw materials i.e. fly ash & lime is collected and weighted as per the recipe mix (Fly Ash: 91 %, Lime: 03 %).

b) Mixing:

(i) Dry mixing of fly ash & lime (prior to addition of water) (ii) wet mixing (after adding water- 11 % of the weight of Fly ash-lime mix) in Sun & planetary mixer. Transfer of mix into ‘Carbonation Reactor’.

c) Carbonation of raw material in a ‘Carbonation Reactor’:

CO₂ is introduced into the pressurised reactor for 30 mins at a pressure of 6-10 bar.

d) Second stage lime addition followed by water addition:

Mix from pressurised reactor is transferred into Attrition Mixer and additional 6% lime along with 4% water is added. The system will include all associated drives for automatic discharge of mix from weigh hopper to mixer including associated conveyors, interconnecting chutes etc in different section of the plant

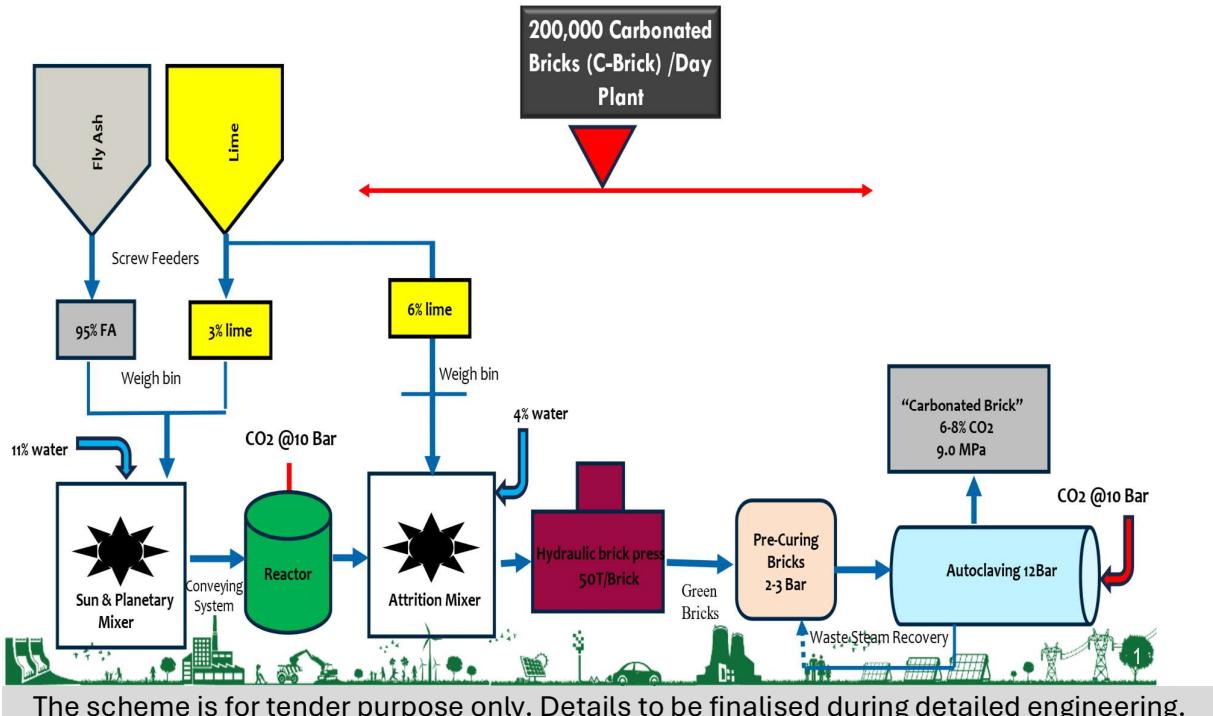
e) Compaction using high pressure hydraulic press:

After mixing, the material will be fed through conveyors from mixer to associated box feeder & compacted using high pressure hydraulic press to produce high strength blocks. Pressing force of minimum 50 Ton is to be applied on each brick (on 230x110 mm side).

f) Green product transfer system:

Automated system for (i) Stacking the Green bricks from ‘Hydraulic Brick Press’ on ‘Cubed Green Brick Cage’ and (ii) transferring ‘Cubed Green Brick Cage’ to ‘Pre-curing Chamber’ using L.S.P (Lift, shift & Place), Automated Stacker etc. ‘Cubed Green Bricks Cage’ shall be typically made using MS curing frames with suitable painting /coating. In this ‘Cubed Green Bricks Cage’, green bricks are placed on curing frame and further these curing frames will be placed upon one another, using automated stacker so that bricks don’t fall from curing frames while movement to ‘Pre-curing Chamber’ and finally to autoclave for steam curing and CO₂ curing in autoclave-based carbonation chamber.

g) Green Brick Steam pre curing:



Utilization of 'Autoclave' waste low pressure steam along with pipework, humidity measurement & control system, ductwork, valves, dampers, blower, drains, exhaust, safety etc. Automated transportation system for movement of 'Cubed Green Bricks Cage' inside 'Pre-curing Chamber' - using specially designed L.S.P (Lift, shift & Place) involving rails, sensors, instrumentation to ensure easy of operation.

h) Steam curing in autoclave with 'Cubed Green Bricks Cage' transfer & handling System:

The green blocks are placed from pre curing chamber to the autoclave chamber for steam curing for 6 hours at peak pressure of 12.5 kg/cm² (excluding the time for pressure building and pressure release) and temperature 190±5 °C. The system will include L.S.P system for movement of 'Cubed Green Bricks Cage' from Pre-Curing Chamber to autoclave & subsequently 'Steam Cured Bricks' from autoclave to de-stacker along with rails, instrumentation etc. Number & dimensions of autoclave shall be designed based on the assumption of a 12-hour autoclave cycle including loading and unloading with design pressure of minimum 16 Bar & temperature 200 deg C.

i) CO₂ Autoclave Curing:

The steam cured bricks are further exposed to CO₂ at 6-10 Bar for 60 minutes in a separate CO₂ Autoclave.

There will be provision for (i) safe venting of residual CO₂ from all 'CO₂ Autoclave' and