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TNO-rapport
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Informatie

CFBA-BUILDING PRODUCTS

projectnummer:

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auteur

A.H. de Vries

Aan:

Potentiële deelnemers consortium

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TPD vervult vanuit een multi-disciplinaire aanpak opdrachten voor bedrijfsleven en overheid.
Kennisgebieden zijn: toegepaste fysica, informatica, mechanica, elektronica, materialen en procestechnologie.

Nederlandse Organisatie voor toegepast-natuurwetenschappelijk onderzoek TNO

Op opdrachten aan TNO zijn van toepassing de Algemene Voorwaarden voor onderzoeksopdrachten aan TNO, zoals gedeponeerd bij de Arrondissementsrechtbank en de Kamer van Koophandel te 's-Gravenhage.

1. INLEIDING

Door het Regional Research Laboratory Thiruvananthapuram (RRL-T) Kerala India en TNO afdeling keramiek is gezamenlijk een procédé ontwikkeld om van vliegas en een geringe hoeveelheid plaatselijk aanwezige klei bouwmaterialen te maken. De werknaam voor de ontwikkelde produkten is "CFBA-BUILDING PRODUCTS "
CFBA staat voor Clay, Fly-ash, Binder, Additives.

Half 1994 werden de instituten benaderd door Mr. Kallol Basu General manager Ash Utilisation & Coal Mining Projects van de Calcutta Electricity Supplier Company (CESC) Limited in Calcutta India om de mogelijkheden van het door ons ontwikkelde proces toe te lichten.

Door de elektriciteits maatschappij CESC wordt in Calcutta India een nieuwe, 500 MW, elektriciteitscentrale gebouwd. Door de overheid is als randvoorwaarde bij de te verlenen vergunning gesteld dat er voor het opstarten van de centrale een oplossing moet zijn voor het verwerken van het te produceren vliegas. De door de centrale te gebruiken kolen bevatten namelijk tot 40% as.

De heer Kallol Basu is aangetrokken om dit probleem op te lossen. Hiervoor heeft hij in de hele wereld instituten en firma's benaderd die mogelijke toepassingen van vliegas aanboden. Uit deze inventarisatie zijn 20 potentiële oplossingen gekomen. Hieronder bevonden zich o.a. ook aanbieders als Aardelite en Hoogovens maar ook Amerikaanse, Chinese en Japannerse firma's. Na een uitgebreide analyse van alle aangeboden mogelijkheden is het TNO-RRL procédé als het meest aantrekkelijke naar voren gekomen. Het probleem is echter dat alle andere aanbieders complete installaties aanboden terwijl TNO-RRL alleen een op het laboratorium getest procédé hadden. Wel is inmiddels voor dit procédé in India patent aangevraagd.

Na overleg tussen Kallol Basu en TNO is besloten dat TNO zal proberen een consortium samen te stellen dat in staat is het procédé verder uit te werken en uiteindelijk een complete produktie-unit aan te bieden. De raad van bestuur van CESC ondersteund deze beslissing. En wil deze mogelijkheid ook beperkt financieel ondersteunen. Wel is gesteld dat er zo optimaal mogelijk van subsidies gebruikt moet worden gemaakt. Zeker in het ontwikkelingstraject waar het risico het grootst is. Maar ook bij de bouw van de uiteindelijke fabriek zijn westerse financiële ondersteuningen welkom.

Wel is ondertussen gebleken dat de behoefte aan goede oplossingen voor de verwerking van vliegas in India groot zijn. Er zal dus een zeer reële kans zijn dat er van de te ontwikkelen produktie-unit meerdere in India gebouwd kunnen worden. Tevens lijkt interesse vanuit westerse landen voor het ontwikkelde procédé niet onwaarschijnlijk.

De informatie die hier gegeven wordt is **vertrouwelijk.** De informatie is een samenvatting (voor het grootste deel in de Engelse taal) van een aantal reeds bestaande stukken. De informatie dient dan ook om potentiële partners in een te vormen consortium te informeren over de stand van zaken, het ontwikkelde procédé en de te bouwen produktie unit.

Bij het uitvoeren van het voorgestelde project zijn een aantal partijen betrokken. Van een aantal van deze partijen is bekend dat zij positief op het project gereageerd hebben.

Een aantal partijen moet nog benaderd worden. Hierna moet een consortium moeten gevormd worden dat verantwoordelijk is voor de uitvoering van het project en voor het verkrijgen van mogelijke financiële ondersteuning van overheden en ontwikkelings-banken.

Partijen in deze zijn:

• Probleembezitter	In dit geval CESC Calcutta	Positief gereageerd
• Opdrachtgever	CESC of een ander	Onbekend
• Producent	CESC of Indiaanse firma	Onbekend
• Produkt afnemer	CESC of Bouwwereld	Positief gereageerd
• Subsidiegevers	Nederlandse overheid	Positief gereageerd
	Nederlandse Ambassade	Positief gereageerd
	Ontwikkelings banken	Onbekend
	CESC	Positief gereageerd

Mogelijke deelnemers consortium:

• Procédé ontwikkelaars	TNO en RRL-T	Positief gereageerd
• Project management	HPR A.dam	In gesprek, positief
• Financiële zaken	HPR A.dam	In gesprek, positief
• Constructeur	De Wever A.dam	In gesprek, positief
• Produktietechniek	Cementbouw	In gesprek

2. KORTE OMSCHRIJVING "CFBA-BUILDING PRODUCTS" PROCÉDÉ

2.1. Inleiding

Het door RRL-T en TNO-TPD ontwikkelde bouwmateriaal bestaat voor meer dan 85 % uit vliegas. Op het procédé is in India patent aangevraagd. Voordelen van het ontwikkelde procédé zijn:

- de basis van het procédé is een hoog gebruik aan vliegas. Bij vestiging op een vliegas producerend bedrijf zijn er dus lage transport kosten voor de aanvoer van het grootste deel van de grondstoffen.
- het produkt is met reeds bekende vormgevings-technologieën te vervaardigen (semi dry pressing). De verwachting is dan ook dat de produktiekosten niet hoger liggen dan traditionele bouwmaterialen.
- de te vervaardigen bouwmaterialen voldoen ruimschoots aan de Indiaanse normen
- het produkt wordt bij lage temperaturen gesinterd (900 - 1000 ^{o}C) Hierdoor is het mogelijk in verhouding tot andere vliegas produkten met minder energie een goed produkt te maken.
- het produkt heeft een hoge maatnauwkeurigheid waardoor verlijming mogelijk is
- het produkt kan in meerdere kleuren vervaardigd worden (o.a. rood, geel, bruin), hierdoor heeft het hetzelfde uiterlijk als de "normale" keramische bouwmaterialen.
- er kunnen meerdere soorten bouwmaterialen van vervaardigd worden (bakstenen in meerde formaten, holle blokken, tegels, scheidingswanden, dakpannen).
- de produkten kunnen indien gewenst geglazuurd worden en zo in een veelvoud van kleuren geleverd worden. Tevens betekent dit een onderhoudsvrije gevelbekleding.
- uit andere onderzoeken is bekend dat het produkt even milieu vriendelijk is als traditionele keramische materialen.

2.2. Toelichting:

Het procédé is in de laboratoriums van RRL-T en TNO-TPD ontwikkeld. De opschaling, bepaling milieu aspecten, fysische eigenschappen en bouwkundige eigenschappen zijn een onderdeel van het opschalingsproces. Het onderzoek naar de opschaling, economische, markt en milieuaspecten moet nog plaatsvinden. Dit onderzoek is echter een onderdeel van het gehele project dat moet leiden tot een produktieunit.
De financiering van dit onderzoek is de inzet van de discussie met Mr. Basu van CESC.

Zowel TNO als ook RRL-T zijn niet geïnteresseerd in het leveren van een produktie unit. Wel zijn we geïnteresseerd om samen met een industriële partner het procédé verder te ontwikkelen tot een produktie proces. Beide instituten zijn primair onderzoeksinstituten. Wel denken wij een procédé te hebben ontwikkeld dat zeer interessant is voor CESC. Tot nu toe is er nog niemand in geslaagd een zo hoog percentage vliegas te verwerken in bouwmaterialen. Het proces biedt tevens de mogelijkheid om voor India nieuwe produkten te ontwikkelen zoals scheidingswanden en geglazuurde buitenbekleding.

3. CFBA-BUILDING PRODUCTS SYSTEM

THE TECHNOLGY
THE PRODUCTS
PRODUCTION PROCESS

3.1 CFBA-BUILDING PRODUCTS TECHNOLGY

The “CFBA-BUILDING PRODUCTS “ technolgy is an exclusive technology (patented) with allows mixtures, formed out of flyash, clay, additives and a binder to be transformed into high quality building materials. Such a transformation is carried out in a high temperature kiln. The transformed materials have the same physical properties as ceramic building materials.

“CFBA-BUILDING PRODUCTS“ opens new perspectives. It contributes significantly towards solving a number of important problems in the field of ashes of coal-fired power-stations. Problems related to supply electrical energy, to the environment, to the residues, and to building industry.

“CFBA-BUILDING PRODUCTS “ are an innovative product that is patented in India and developed in collaboration between the **CSIR institute** “RRL-T “ India and **TNO** ceramic department in the Netherlands.

“CFBA-BUILDING PRODUCTS “ gives the possibility to use more than 85% of flyash in ceramic building materials. All the other materials are local aveliblel.

“CFBA-BUILDING PRODUCTS“ **are products with a future!**

3.2 CFBA-BUILDING BLOCKS PRODUCTS

With the "CFBA-BUILDING PRODUCTS" production process we can made a range of different building products.
- Bricks in different formats
- Tiles for wall and floor
- Hollow blocks
- Separating blocks
- Paving bricks

The product can be made in different colours and if necessarily glazed.

- The potential market:

The question whether there are good marked possibilities for the "CFBA-BUILDING PRODUCTS" is fundamental. The size of the potential market is determined by three factors:

- The application possibilities of "CFBA-BUILDING PRODUCTS".
- The size of market for these applications.
- The competitive position of "CFBA-BUILDING PRODUCTS" in relation to existing products.

- The application possibilities of "CFBA-BUILDING PRODUCTS".

"CFBA-BUILDING PRODUCTS" finds its most important application in the replacement of existing building products. Especially in the replacement of ceramic materials. An other market is a new market. Glazed products in different colours, separating blocks and Paving bricks must find her way to the marked.

- The size of market for these applications.

To make a rough estimate of the potential marked for "CFBA-BUILDING PRODUCTS", is not easy. But the nearby marked is the building market in the city Calcutta which is still growing. Also the amount of inhabitants is growing from now 14 million people.

- The competitive position of "CFBA-BUILDING PRODUCTS" in relation to existing products.

From a point of view of application and sales position, there are no real obstacles for commercial success of "CFBA-BUILDING PRODUCTS" in relation to existing products.

The last question still to be answered concerns the chances of "CFBA-BUILDING PRODUCTS" to win a reasonable share of the market. This will depend mainly on the competitive position between other building materials and "CFBA-BUILDING PRODUCTS".

There are three important criteria in this matter:

1. Quality
2. Availability
3. Sales price

- Quality

As the production process can be controlled completely, the quality of the end product can be guaranteed. Variations in the composition of the raw materials can be corrected easily by adapting the mixing ratio.

- Availability

The most of the raw materials for "CFBA-BUILDING PRODUCTS" are so-called residues and non-scare raw materials. So there is no lack of availability of raw materials. The production unit should be build on the same location as the powerplant. So there should be a combination in producing the main raw material and producing the "CFBA-BUILDING PRODUCTS".

- Sales price

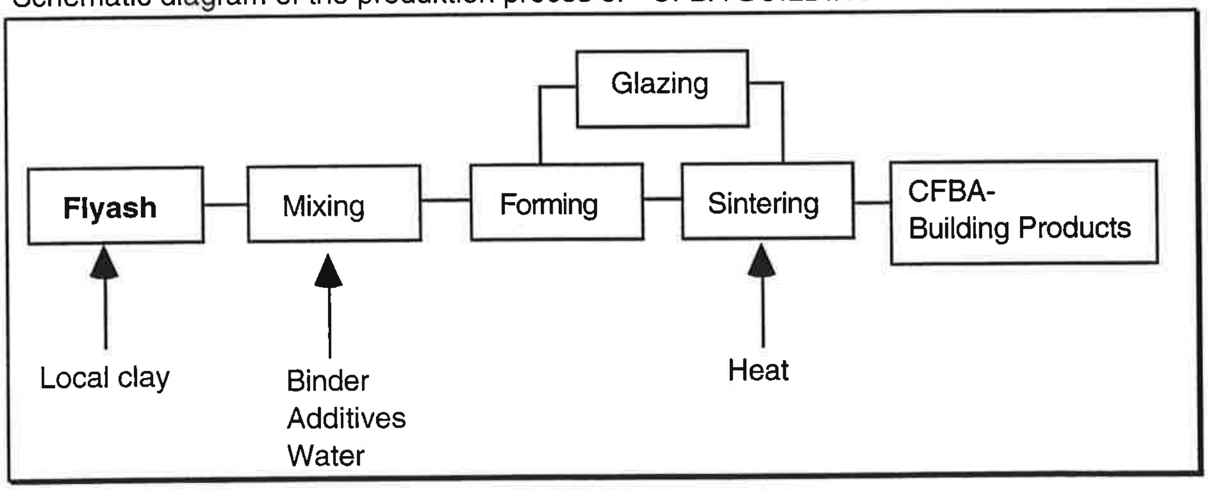
The basic condition for pricing of "CFBA-BUILDING PRODUCTS" is that it should be the same price or cheaper than the traditional building products, because "CFBA-BUILDING PRODUCTS" is equal in quality as ceramic building materials.
It is not possible to make a general cost calculation. This depends for a important part on the production unit for "CFBA-BUILDING PRODUCTS". But from an number of case-studies, it appears that, in many instances, production of "CFBA-BUILDING PRODUCTS" is economically feasible in relation to existing disposal cost.

3.3 CFBA-BUILDING PRODUCTS PRODUCTION PROCESS

3.3.1. Introduction
We can not give the full details of this process. Suffice to say it is based on a well mixed mixture of the raw materials, forming by semi dry pressing and sintering of the formed products. The optimal composition of the mixture varies depending on the avaible materials and the properties required. All raw materials are local available.

3.3.2. Outline of the production process
The production process can be outlined as follows:
- Body preparation
- Storage of individual components
- Mixing
- Storage of mixed body
- Forming
- If necessary glazing
- Firing
- Storage of ready product

Schematic diagram of the produktion proces of "CFBA-BUILDING PRODUCTS"



3.3.3. Discription of the produkcion process

3.3.3.1 Recipe compositions of "CFBA-BUILDING PRODUCTS"

Flyash	85 - 90%
Local clay	3 - 6%
Binder	1 -3 %
Addiative	2 - 4 %
Water	8 - 12%

3.3.3.2. Raw materials preparation and mixing:

Clay should be milled and grinded. The raw materials will be mixed on a semi-dry base. The water content of the mixture will be 10-12 %. The binder will be mixed with water before mixing with flyash and clay. Between the mixing process stage and the forming process there shoud be a storage for the mixture that has been prepared.

3.3.3.3. Forming process:

The forming process is a semi-dry process. For this process there will be needed at last two presses (Dorstener). The presses should be simultaneous and result in a uniform compaction by means of upper and lower pressing cylinders. There should be no deformation of the press table. And a compact construction of the hydraulic system for easy maintenance.

3.3.3.4. Drying:

The formed products shoud be dried until about 2-3% moisture. This can be done in a tunneldryer or in a chamber dryer. Approximate drying time is 24 h. Drying is possible on the tunnel kiln cars.

3.3.3.5. Glazing:

One of the possibilities to make different products is glazing the green products. As a rule, glaze compositions are purchased in readymixed powderform, although some of the major manufactures develop and mix their own glazes.

The powdered glaze is mixed with water at a ratio that depends upon the porosity of the product to be glazed, the desired surface finish, the target layer thickness and the method of application (slinging or gunning). The glaze is applied to either the green compact or- more frequently - the dry unfired bricks or tiles (the once-firing method).
The average glazing line comprises of a conveyor system serving several glazing stations equipped with either glaze guns or glaze slingers, with drying zones located in between. several different glazes can be applied consecutively, whereby the time intervals can be adjusted to result in a wet - on wet or wet - on dry application, or some intermediate point.

3.3.3.6. Firing of the products:

The bricks should be fired at a temperature of 950 -1050^{o} C. Approximate firing time is 60 h in total. The kiln must be fired 24 h/day.

After firing the produced bricks shoud be stored near the factory before transportation to the customer.

4. THE CALCUTTA ELECTRICITY SUPPLIER COMPANY CASE

4.1. Conditions for utilisation of fly ash given by CESC.

For the utilisation of fly ash as alternate for the use of raw materials for building products CESC has set some conditions. These conditions are:

- No transport of the fly ash (the factory has to be situated near the fly ash producing power plants)
- It should be a bulk product
- Low production cost of the products
- High material quality
- Without using limestone (there is no lime stone available near Calcutta)
- Costs of fly ash: approx. 400 Rp for a truck.

4.2. Basis production data given by CESC

The production unit will be based on the folowing data:

Production per day = 100.000 bricks 200 x100 x100 mm weight 3 kg/p
Production per year = 30 million bricks

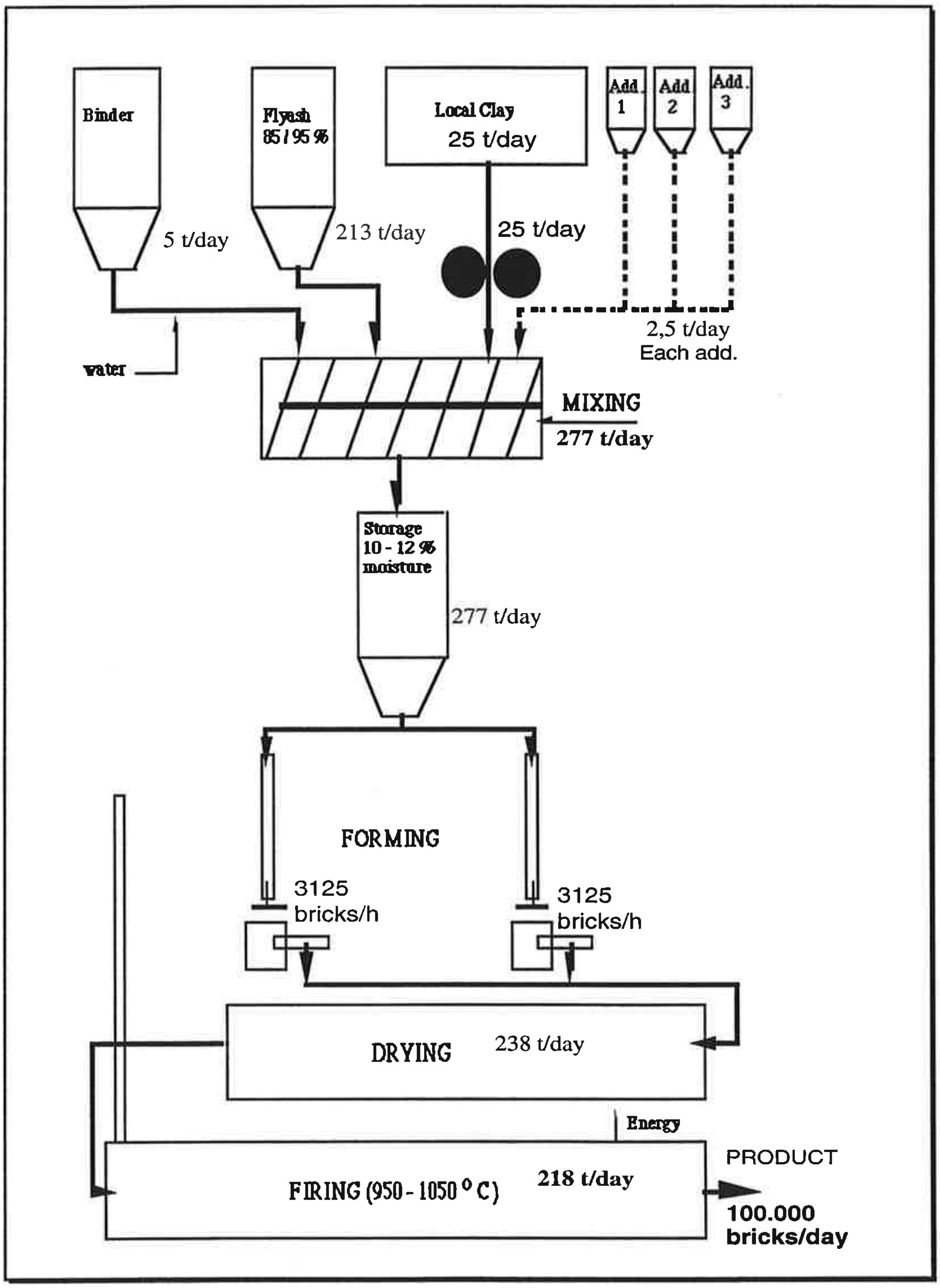
Production:
2 shifts at 8 h per day
6 working days a week

Firing and drying;
24 h/day and 7 days a week

Manpower:
The normal manpower that is used in an Indian brick factory is 25.000 Kg/ 6 mandays.
For a this production based on the Indian way to produce we have calculated with 50.000 kg pro 6 man/days That neams that for the total production the manpower needed is about 40/day

The plant should be located nearby the powerplant.

Process flow sheet for the "CFBA-BUILDING PRODUCTS" process based on the CESC data for producing 100.000 brick/week.



4.3. CESC flyash brick production plant approximate raw materials requirements

	%	kg/h	kg/day	ton/year
Flyash	85	13281	212500	63.750
Clay	10	1563	25000	7.500
Binder	2	313	5000	1.500
Additive 1	1	156	2500	750
Additive 2	1	156	2500	750
Additive 3	1	156	2500	750

5. BACKGROUND INFORMATION ON THE MATERIALS

5.1. Fly ash and coal residues as raw materials for building products.

5.1.1. Production of power station coal ash in India .

In India, the annual production of power station coal ash is approximately of the order of 30 million tonnes per year. This is likely to increase to 80 million tonnes by the turn of this century. This causes environmental hazards. To reduce the problem of fly ash dumping, it is imperative that fly ash should be utilised in an environmentally safe manner either as a raw material for other products or for some other beneficial purposes. While such large quantities of waste materials get accumulated facing very serious problems of safe disposal, the building material industry is on the verge of diversification and it could be possible with the help of the industry to sensibly put to use such waste products into very useful, interesting and cost effective items. The idea of "No Waste" that is accepted and followed in developed countries can be transferred to our situation.

However, although there are industrially feasible methods that have been developed and practised abroad effectively, it is not sensible to exactly imitate those technologies. For example, fly ash is a "Scarce Material" in the Netherlands to the extend they import from other countries. However, the quality of the fly ash differs mainly concerning residual carbon and other fluxes and hence it becomes very difficult to follow same processes for utilisation. Hence the situation calls for a definite way of our own thinking to prove the possibilities of an integrated approach for the fly ash and clay based building materials.

5.1.2. Building material industry .

Building material industry is ever progressing over the past few years in India and clay base building materials form the major share in total building constructions. Due to this activity, indiscriminate mining and exploitation of the good quality soil in the already depleting agricultural land is noticed with great concern. A strong feeling of conservation of the soil has come into being. On the other hand, due to the increasing industrial activity, large quantities of "waste" materials, essentially by-products, have accumulated which find grave problems for disposal. A few of them which require immediate attention are the coal ash/fly ash, coconut pith, lime sludge, phosphogypsum etc. There have been scattered and isolated attempts to utilise some of these "wastes" or "by-products" in good quality building materials.

5.2. FLY ASH AND COAL RESIDUES

5.2.1 Flux bonded fly ash

Fly ash is in the most part the calcined product of the clay minerals contained within the power station feed-coal which have been transformed in the boilers from their original crystalline structure into minute beads of glassy material. In this state considerably less heat-work is required to return it to a “fusible” condition than is needed to achieve the same state in a raw clay - which during firing has to pass through a complex succession of chemical changes including the removal of crystal-lattice water and the oxidation of associated carbonates ferrous and calcareous compounds, before an equivalent glassy phase can be attained. Fly ash is therefore a silica-rich high-temperature exposed active material which contains sufficient fluxing oxides of calcium, magnesium alkali oxides etc. By suitably triggering these minor phases by addition of low melting ceramic oxides and by incorporating certain clay based binders, it is possible to consolidate fly ash (up to 90% or above) to hard blocks. Early work in this line has been already done at RRL(T) and compressive strength of about 100-120 Kg/cm^2 has been obtained. The carbon present in fly ash possibly would contribute to energy by burning and hence acts as an internal fuel also. The concept of 'Flux Bonded Fly Ash' is based on triggering the already existing fluxes in the fly ash to form low melting glasses. This concept is novel, and a detailed study on the constitution, distribution, formation kinetics, viscosity etc., would be investigated. The effect of unburned carbon present in the fly ash and its effect on the physical nature of the grain boundary phase will be studied.
Further, the morphological changes occurring in the fly ash particles under the flux bonding environments and the variation of these features with respect to the different Indian fly ashes will be investigated. Essentially it will bring out adequate level of information with respect to crystalline and amorphous phases bonded ceramics.
Some coal waste materials can be recycled to new products. The possibilities for development of these materials depends on the structure of the available fly ashes.

New Products are:
- Activated-slag-cement
- Polysil-concrete
- Artificial-gravel
- Calcium-silicate-bricks
- Ceramic- bricks
- Ceramic-paving-stones
- Calcined-gypsum-anhydried-products
- Anhydride-self-levelling-floors
- Ceramic- gravel
- Isolation materials

5.2.2. Chemical and physical properties of fly ash

Coal contains inorganic mineral components, which remain as ash after burning. The ash can take two forms:

- Bottom ash

this is the fraction that is collected at the bottom of the incinerator and consists of coarse and heavy particles;

- Fly-ash

this is the lighter fraction which has been carried away with the flue gases.

In powdercoal fired electricity plants, 80%-90% of the total ash consists of fly- ash. The fly-ash is almost completely collected in the kiln stack through air filters. The chemical and physical properties of the fly-ash are strongly dependent on the type of coal used, the grain size of the coal and the way the plant is operated.

Fly-ash consists mainly of oxides (about ten), of which SiO_2, Al_2O_3 and Fe_2O_3 form more than 80% of the mass. Furthermore, a large number of trace elements are usually analysed, sometimes more than 50, most of which in low (0.1 - 0.01% $^m/_m$) or very low (<0.01% $^m/_m$) concentrations. Usually a certain percentage of unburned coal is also present.
Morphologically, fly-ash consists of round particles with a glassy structure. A small fraction of the minerals occurs in crystalline form, for instance quarz (SiO_2), hematite (Fe_2O_3), mullite ($Al_2O_3.SiO_2$). A separate fraction, 4% - 5% of the fly-ash, consists of so- called floaters, which are hollow glassy particles filled with gas bubbles (N_2 en CO_2), which makes them float on water. Their properties differ somewhat from the other particles.

6. BACKGROUND INFORMATION ON THE PARTNERS

6.1. CALCUTTA ELECTRICITY SUPLYER COMPANY (CESC) LIMITED

CESC LIMITED
Poddar Court 18
Rabidra Sarani
Calcutta 7000 001
India
Contact: Mr. Kallol Basu

CESC in Calcutta India is one of the fast expending power groups in India. The total expected power production in 1996 is 1080 MW. All the power plants are coal burned plants. The expected production of power station fly ash in 1996 is about 2500 tons of fly ash. A solution has to be found for the daily production of 2500 tons of fly ash/day.

Power production of CESC:

At the moment:	4 power plants, producing	540 MW	(2 plants very old)
In the near future	additional	540 MW	
Subtotal:		1080 MW	
Expected in future	approx.	2000 M W	
Total in 2000 AD	approx.	3000 MW	

The annual production of fly ash of the power plants of CESC is.

At the moment	1100 tons of dry fly ash a day 600 tons of bed ash.
Expected for 1996, extra	1400 tons of dry fly ash 400 tons of bed ash

6.2. NETHERLANDS ORGANISATION FOR APPLIED SCIENTIFIC RESEARCH (TNO)

Institute of Applied Physics (TPD), Department of Ceramics and Glass
P.O. Box 595
5600 AN Eindhoven
The Netherlands

TNO is the Netherlands Organization for Applied Scientific Research. TNO's primary tasks are to support industry, the authorities and other groups of the community in technological innovation, and to assist clients in solving problems. TNO does this by rendering services and translating technologies into practical applications, either for individual companies or for research associations.

TNO is a fully independent R&D organization with a staff of about 4000 and a total turnover of more than 350 million ECU a year. TNO's R&D takes place at fifteen institutes and laboratories, spread throughout the Netherlands.

Dutch industry and ministries are important clients of TNO. Not only does TNO work for individual companies; groups of companies or a whole branch of industry also regularly call upon the services of TNO. A large number of industrial clients belong to the small and medium-sized enterprises (SME's) In addition, TNO works for an increasing number of companies and establishments abroad. At present TNO derives about 25 per cent of its market turnover from contract R&D for the foreign private sector and international organizations.
R&D conducted by TNO is largely directed at answering questions of practical importance. However, TNO maintains close contacts with basic research institutions, both at home and abroad, in order to translate the most up-to-date technologies and insights into practical applications. TNO's major activities are R&D, the transfer of know-how, and the application of technologies in products and processes.TNO is a member of the European Association of Contract Research Organizations the European Materials Research Consortium (EMARC) and the European Industrial Research Management Association (EIRMA).

TNO Institute of Applied Physics (TPD)
The TNO Institute of Applied Physics operates within TNO. The TPD has a staff of 350 and a gross turnover of DFL. 65 million. Its major activities are Instrumentation, Optics, Acoustics, Process Physics, Computer Sciences and Inorganic Material Research.
The Materials Department is subdivided into Technical Ceramics, Traditional Ceramics , Glass Research and Inorganic Material Chemistry. The Inorganic Material Research Department is located on the grounds of the Eindhoven University of Technology, close to the faculty of Chemical Engineering. The department has a staff of 50 and a gross turnover of DFL. 12 million.

TNO-TPD Department of Traditional Ceramics .
The TNO group of Traditional Ceramics was founded over half a century ago as an independent research institute. Today it forms part of the TNO Institute of Applied Physics. The main field of work of the group is traditional clay-based ceramics. The group covers both whiteware, sanitary ware, tiles and building ceramics. Collective R&D for the various branches of the Netherlands ceramics industry is an important activity. Important fields of research in building ceramics are the use of waste materials, energy and environment of the ceramic process, drying of bricks and roofing tiles and fast-firing. The activities are based on a thorough knowledge of the specific problems and latest technological developments in this branch of industry. The group of Traditional Ceramics has a staff of 12 and a gross turnover of DFL. 2.2 million.

6.3. THE COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH (CSIR),

Regional Research Laboratory
Thiruvananthapuram 695 019
India

Regional Research Laboratory (Research Institute) with its primary charter to cater to regional research interests has been working in clay based products for over 10 years and a few process flow sheets have already been successfully brought out. These processes have been based on concepts of:

(a) conservation of material and energy (Lightweight Bricks)
(b) alternate raw materials (laterite)
(c) alternate processes (chemical bonding)
(d) high strength building materials (vitrified tiles)
and are being tried at various scale up levels. In fact, one process for light weight bricks using clay-coconut pith mixtures is on the verge of technology transfer to an industry. RRL(T) has also been involved successfully in working on fly ash and cold bonding of ceramic materials. All these are supported by i nternational publications and project documents.
(e) Benefaction and utilisation aspects of phosphogypsum -
The phosphogypsum from M/s. Fertilisers and Chemicals Travancore Ltd. was analysed and methods for benefaction were developed by the proposing group in RRL(T) earlier. It has been seen that the phosphogypsum could be a potential raw material for plaster of paris. However, the present proposal would facilitate further large scale utilisation of this waste material.