PROFESSIONAL CEMENT PLANT OPTIMIZATION, MODERNIZATION AND ENERGY CONSERVATION

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ABSTRACT

Optimization, modernization and energy conservation projects are on the daily topic-list of every cement plant operation and management. However engineering is not the key-business of a cement plant and hence the resources, the judgement and the overview on technical developments are often limited. For this reason many of such projects fail or its implementation exceeds the related time schedule.

Specialized consulting engineers support the cement plants by professional and successful implementation and execution of such projects. At the beginning a plant audit determines the actual situation and the target of the project. On this basis all the aspects of a project, such as technical, commercial, environmental, logistical and organizational are considered, evaluated and elaborated on in a feasibility- and a project study. These documents often have to be of “bankable” quality and are used for financial and permitting procedures.

The border lines between optimization, modernization and energy conservation projects are interactive in many cases.

In the following some typical examples of plant optimization, modernization and energy conservation projects are given indicating the wide range of such projects:

Typical plant optimization projects:

- Technical and commercial optimization of the raw mixture, the clinker and the cement quality.
- Utilization of sewage sludge from waste water treatment plants to save on primary fuel as well as the use of clay as raw material

Typical plant modernization projects:

- Complete consultancy for conversion of a wet- to a dry process plant including capacity increase from 2400 tpd to 4500 tpd.
- Capacity increase of an existing production line from 2400 tpd to 3000 tpd.

Typical plant energy conservation projects:

- Modification of the coal mill for operation with pre-heater exhaust gas for high volatile coal and utilization of 14 % RDF in the pyro-system.
- Increase of efficiency and capacity of pre-heater, calciner and cooler.

PEG S.A. as the leading independent and international consulting engineer and partner of the Indian Cement Industry supplies experienced consultancy and engineering services for all kinds of plant optimization, modernization and energy conservation on a customized basis for maximum profitability and return of investment.

1. INTRODUCTION

Optimization, modernization and energy conservation projects are basically concerning all technical sections and the complete field of operation within a cement plant. Such projects are the key to increase the production output and the profitability. However all the projects have to be carefully planed and executed to receive the maximum benefit whilst also reducing project risks and damages.

Specialized consulting engineers support the cement plants by professional and successful implementation and execution of such projects. At the beginning a plant audit determines the actual situation and the target of the project. On this basis all the aspects of a project, such as technical, commercial, environmental, logistical and organizational are considered and elaborated in a feasibility- and project study. These documents often have to be of “bankable” quality and are used for financial and permitting procedures.

PEG services as a leading international and independent consulting and engineering company are not just limited to the project planning but can also include the complete project execution.

2. EXAMPLES OF TYPICAL PLANT OPTIMIZATION PROJECT

As there is a wide range of projects and activities only a few typical examples of cement plant optimization, modernization and energy conservation projects executed by PEG will be introduced and discussed.

2.1 TOL CEMENTO / COLOMBIA: TECHNICAL AND COMMERCIAL OPTIMIZATION OF THE RAW MIXTURE, CLINKER AND CEMENT QUALITY

The target of this optimization project was to improve the technical, organizational and commercial situation of the raw material preparation and raw mixture design in the Tol Cemento plant of Cementos Argos Group in Colombia.

Situation:

The pre-mixture consisting of marl, clay, iron ore and chert was prepared on unsuitable dump piles in the quarry area. This dump pile pre-mix was mixed up with limestone on trucks by counting on front loader shovels and jointly dumped into the crusher. The crushed material was transported by a tripper car belt to a stockpile. This resulted in additional disproportioning of the compounds. As a consequence the standard deviation of the LSF in the raw mixtures was ranging from 10 % to 18 % resulting in significant operation problems of the kiln line and unacceptable fluctuations of the clinker quality.

Solution:

The expansive and complicated but unsuitable pre-mixture preparation on dump piles in the quarry area was eliminated. To mix the various materials and achieve a suitable homogeneity without installation of new crushing equipment the existing crusher was modified into an integrated system (see Fig.1). This was achieved by the addition of a second feed hopper with apron feeder and the installation of a PGNA-Analyser for quality control. This integrated crushing system is operated by proportionally feeding limestone and marl into the first bin and clay into the second feed hopper. The chemical composition of this pre-mixture is controlled automatically by PGNA-online analysis.

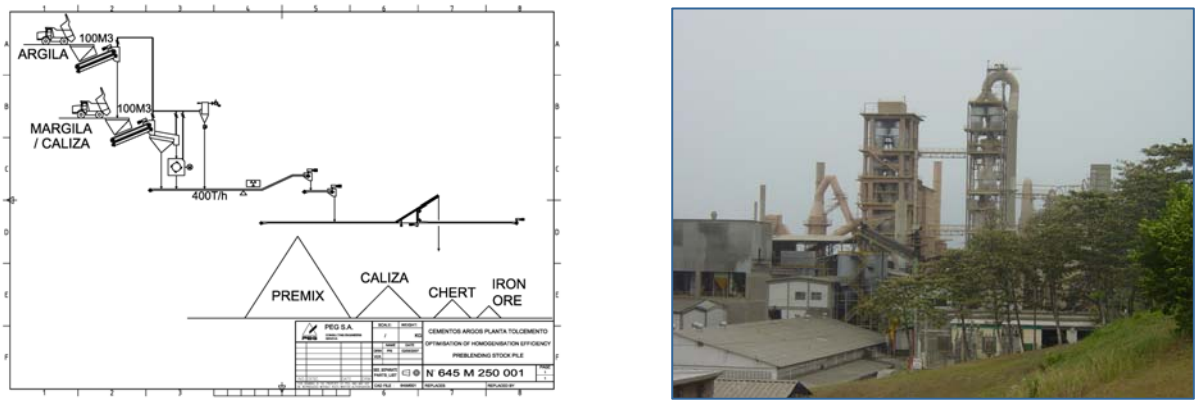

Fig.1: Modification of pre-mixture crushing system at Tol Cemento / Colombia.

By admixture of clay to the jointly crushed pre-mixture reduced the separation effect caused by the dropping of the pre-mixture by the tripper car. The pre-mixture is corrected by high grade limestone and iron ore. A small quantity of high grade limestone is crushed separately by using the integrated crusher system. For the corrective materials an additional feed bin with a weigh feeder was installed. As a result the standard deviation of the LSF of the raw meal was reduced to 4 %. Further homogenisation is achieved in the homogenization silo.

2.2 ADANA CIMENTO, MESKI & EUB / TURKEY: UTILIZATION OF SEWAGE SLUDGE FROM WASTE WATER TREATMENT PLANT TO SAVE PRIMARY FUEL AND CLAY AS RAW MATERIAL

Target of this project was to utilize waste water sewage sludge as an alternate fuel and raw material in the clinker production of the Adana Cimento plant. This project was subsidised by the European Development Bank. The sewage sludge had to be dried to a maximum moisture content of 15 % in the waste water treatment plant to reach the following properties:

Properties of Sewage Sludge:

Moisture content:	15	%
Net Calorific value:	2400	kcal/kg
Organical content (dry matter):	55	%
Anorganical content (dry matter):	45	%

The complete drying, transport and handling facilities were designed. For the successful utilization of the sewage sludge a careful raw mixture calculation including a related fuel scenario (see example Fig. 2) had to be performed considering the influence of heavy metal elements and volatile compounds.

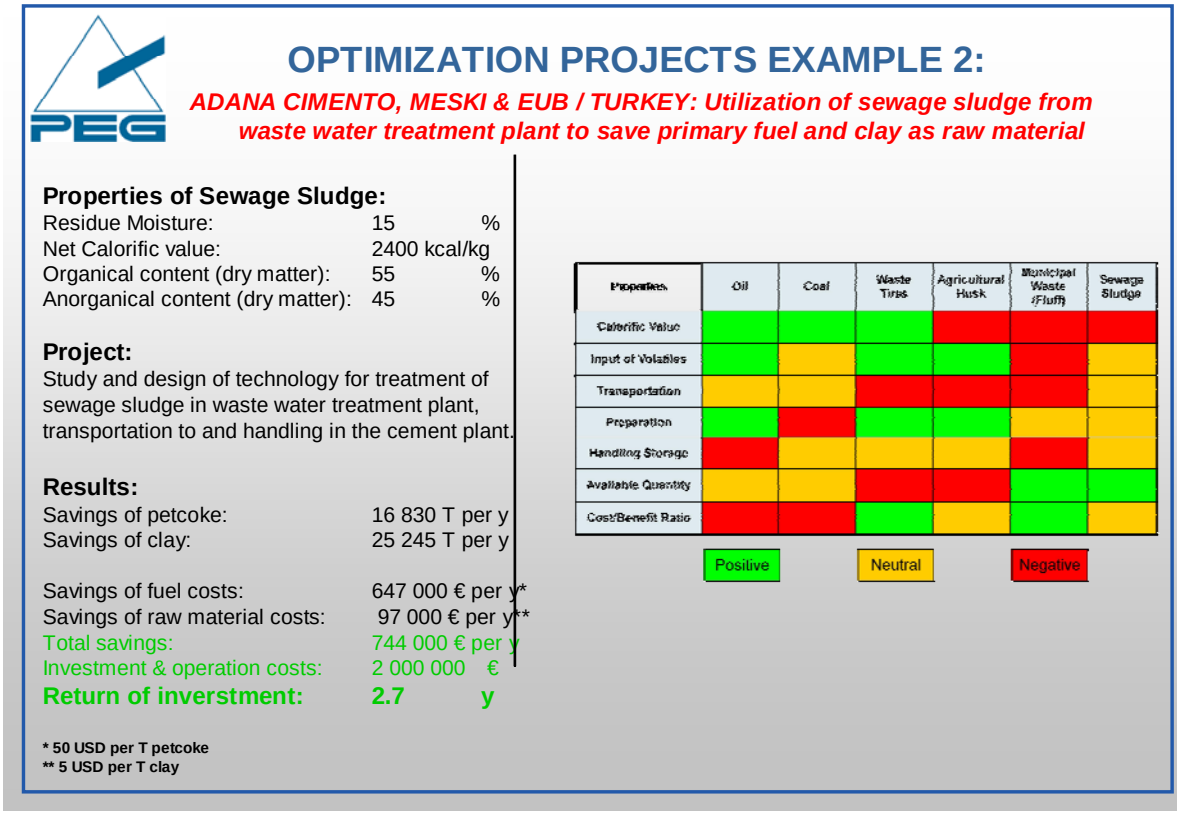

Fig.2: Typical fuel scenario considering the properties of different fuels.

Without disposal fee the result of the sewage sludge utilization is represented by the following figures:

Results:

Savings of petcoke:	16 830 T per y
Savings of clay:	25 245 T per y
Savings of fuel costs:	647 000 € per y*
Savings of raw material costs:	97 000 € per y**
Total savings:	744 000 € per y
Investment & operation costs:	2 000 000 €
Return of investment:	**2.7 y**

*** 50 USD per T petcoke**
**** 5 USD per T clay**

3. EXAMPLES OF TYPICAL PLANT MODERNIZATION PROJECTS

3.1 AKMENES CEMENTAS / LITHUANIA: COMPLETE CONSULTANCY FOR CONVERSION OF A WET- TO A DRY PROCESS PLANT INCLUDING CAPACITY INCREASE FROM 2400 TPD TO 4500 TPD

The target of the ongoing project is the conversion of the existing 2400 tpd (2*1200 tpd) production line to a new dry process line with 4500 tpd clinker production capacity. In addition the specific heat consumption shall be reduced from 1450 kcal/kg to 840 kcal/kg. Also the utilization of waste tires as alternate fuel is a major target of the project. To limit the investment costs to a minimum, the existing limestone crushers, cement mills and kiln foundations have to be used, renovated and extended. To limit project contingencies the execution is based on a multi package project of different suppliers, local erection and local manufacturing.

PEG provided to complete techno-commercial feasibility study and performed the complicated tendering, proposal evaluation and contracting and negotiation process. The supervision of the design, the equipment manufacturing and the construction and erection as well as the project management and the commissioning support on site will be performed by PEG.

3.2 COSTA RICA PLANT: CAPACITY INCREASE OF AN EXISTING PRODUCTION LINE FROM 2400 TPD TO 3000 TPD

This project is dealing with the second step of the complete capacity upgrade. In the first step a new kiln line with a capacity of 3000 tpd of clinker production was installed (PHASE I). In this PHASE II a full techno-commercial feasibility and CAPEX study was elaborated. It included mainly the following topics:

- New integrated crushing raw material crushing system in quarry (Capacity 800 tph)
- 2 km long raw material transport from crusher to stock pile via difficult topography
- Elaboration of different project options: Extension of existing stock-pile or installation of a new stock-pile.
- Addition of a second raw mill or replacement of the existing raw mill.
- Design of a new Pyro-system and raw mill filter.
- Design of all the relevant transport equipment.
- Evaluation of all auxiliary equipment for suitable capacity, e.g. compressed air supply, coal grinding and storage, burner capacities, corrective materials crushing, transports and storage

Fig.3: Quarry of Hocim Costa Rica plant.

Fig.4: Existing raw meal silo of Holicm Costa Rica.

4. EXAMPLES OF TYPICAL PLANT ENERGY CONSERVATION PROJECTS

4.1 CEMEX SOLID CEMENT / PHILIPPINES: MODIFICATION OF THE COAL MILL FOR OPERATION WITH PRE-HEATER EXHAUST GAS FOR HIGH VOLATILE COAL AND UTILIZATION OF 14 RDF IN THE PYRO-SYSTEM

Due to ever increasing fuel costs the target was to change the plants operation from import coal with 25 % volatiles to local lignite coal with up to 40 % volatile matters and a moisture content of up to 20 %. For this reason the coal mill had to be modified form cooler middle air to pre-heater exhaust gas operation.

The project was concluded within a very short time schedule of 10 month from begin of the feasibility study until the actual commissioning of the coal mill modification. PEG executed the complete project according to the following topics:

- Full techno-commerical feasibility study.
- Turn-key execution of engineering, equipment delivery and installation of the inertization gas project.
- Execution of coal mill separator modification.
- Technical key figures: coal mill capacity 20 tph, pre-heater exhaust gas temperature 360 °C, fine coal moisture max. 2.0 %.
- Planning of a rice husk and tyre chip feeding facility to substitute 14 % of the primary fuel.

The installed pre-heater exhaust gas duct, shut off gates, dust settling cyclones with dust transports and the fan are displayed in red colour in Fig.5.

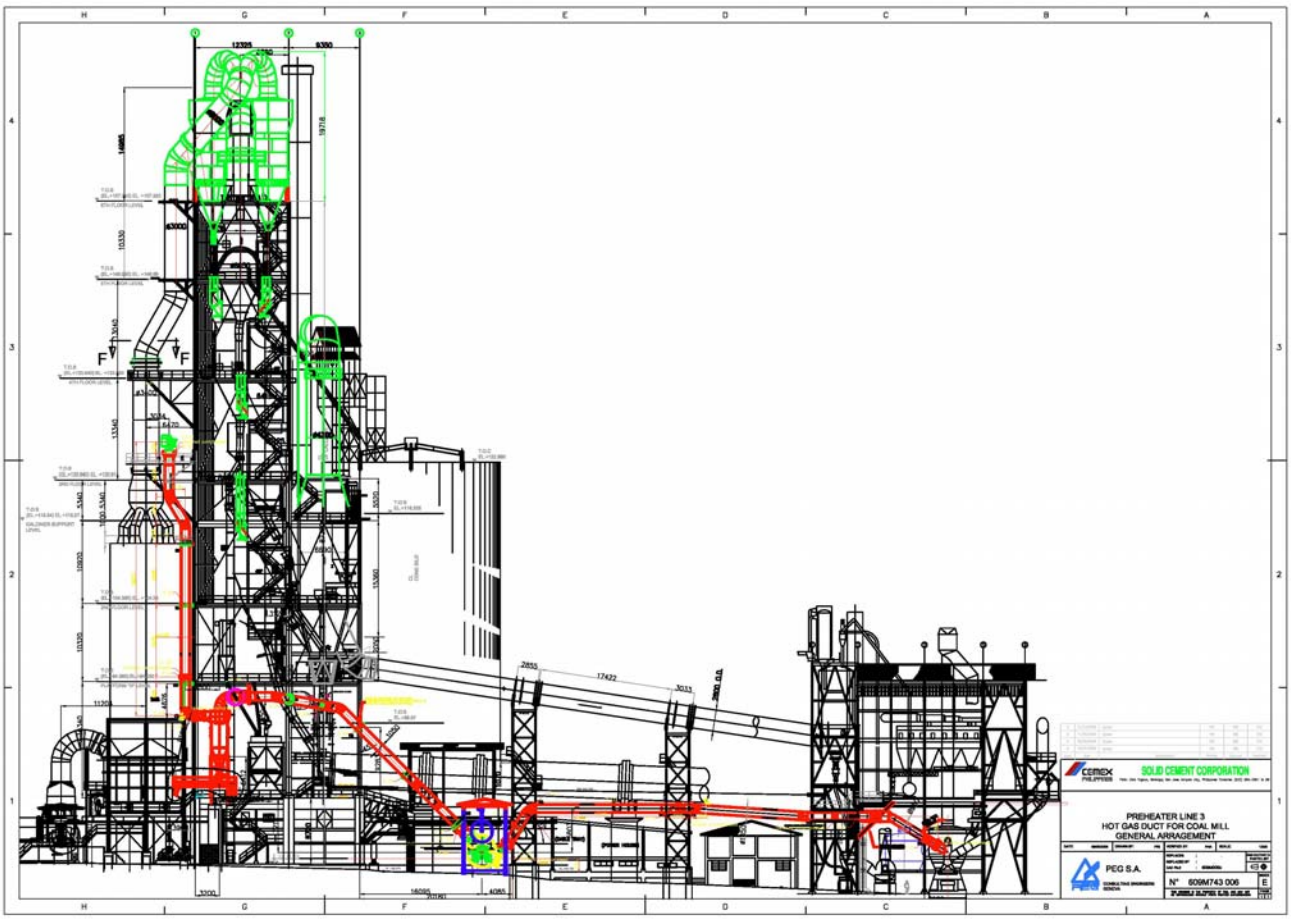

Fig.5: General arrangement of the inertization gas modification of the coal mill of Cemex Solid Cement / Philippines.

4.2 CEMEX SOLID CEMENT / PHILIPPINES: INCREASE OF EFFICIENCY OF PREHEATER, CALCINER AND COOLER AND CAPACITY INCREASE FROM 2900 TPD TO 3350 TPD

Due to the design of the cyclones and the calciners tertiary air inlet only 2900 tpd clinker production could be achieved. With a pressure loss over top of the pre-heater of 79 mbar and an exhaust gas temperature of 400 °C resulted in a specific heat consumption of 950 kcal/kg of clinker.

The project was started with a techno-commercial feasibility and engineering study that resulted in the following major modifications: The replacement of the double cyclone stage (I), extension of the calciner to reach a gas velocity of 16 m/s and a retention time of 3.5 s, modification of the tertiary air inlet and installation of new splash plates and hot meal flaps. All the above modifications were engineered and executed in cooperation with PEG's affiliate CME / Philippines on a turn key contract basis.

The following results were achieved:

- Capacity increased from 2900 tpd 3350 tpd.
- Specific heat consumption was reduced to 760 kcal/kg.

- Reduction of pressure loss from 79 mbar to 64 mbar (see Fig.6).
- Reduction of exhaust gas temperature from 400 °C to 365 °C (see Fig.7).
- Increased calciner gas velocity to 16 m/s and retention time to 3.5 sec. for complete combustion of 14 % AFR.
- Project time from feasibility study to commissioning 10 month.

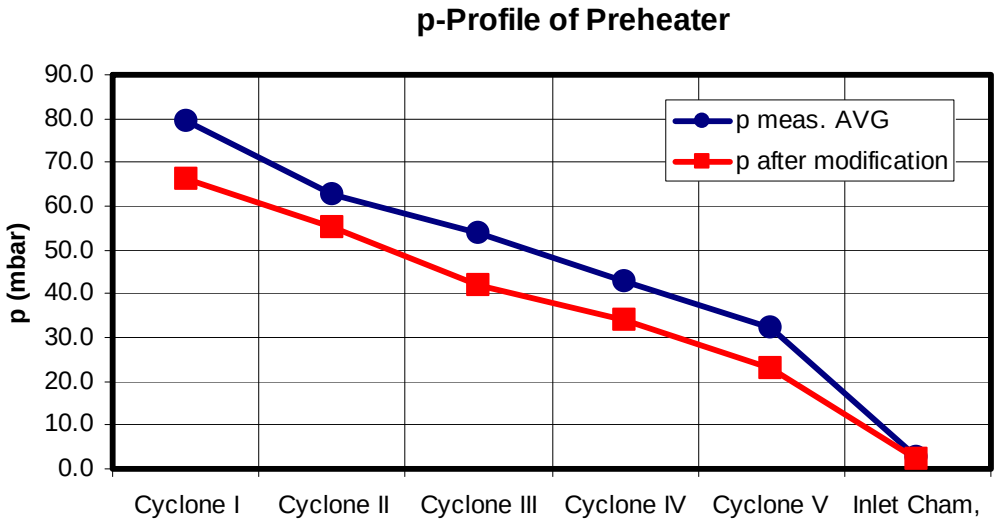

Fig.6: Pressure loss profile of thermal pre-heater and calciner of Cemex Solid Cement / Philippines before and after modification.

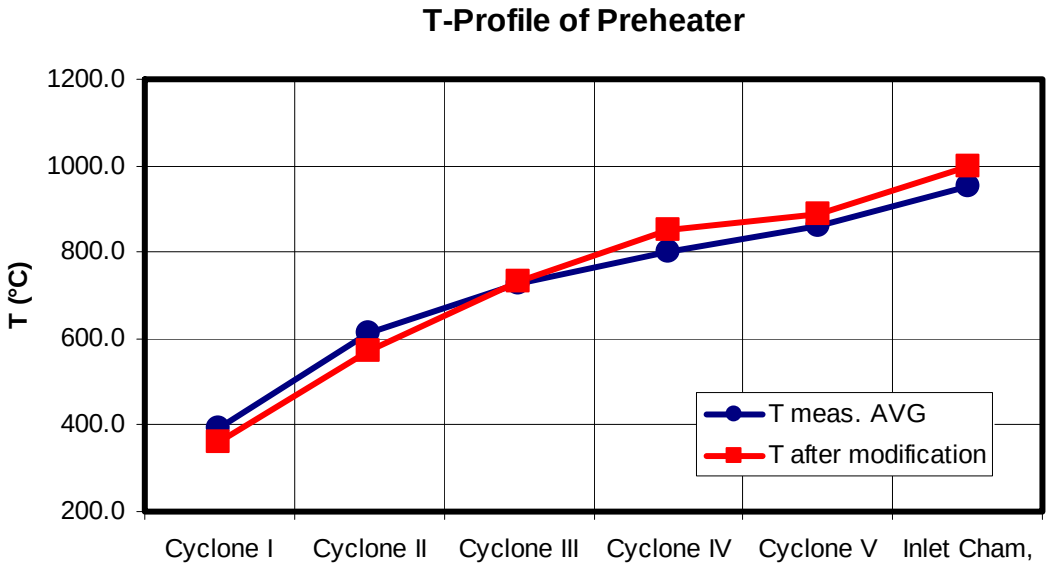

Fig.7: Temperature profile of thermal pre-heater and calciner of Cemex Solid Cement / Philippines before and after modification.

4. CONCLUSIONS

A sophisticated and well experienced plant audit and project study is the basis of every successful project within an existing cement plant. Practically all types of projects from plant optimization, modernization, upgradation and adaptation need to be properly elaborated and evaluated before any major investment can be considered.

All aspects - technical, organizational, logistical, environmental, market and commercial have to be covered. Cement plant optimization, modernization and energy conservation projects and related planning should be carried out by excellent, experienced and independent experts and engineers. Similar studies executed by equipment suppliers could result in a „conflict of interests“ and are usually of non-bankable quality.

PEG S.A. has 42 years of consulting experience and has proven excellence within the cement industry, With our worldwide references and our abilities we are able to cover all types of projects with detailed know-how and experience. This is particularly in the case concerning the cement manufacturing- and the secondary fuel technology.

PEG S.A. is the leading international and independent consulting engineer and a reliable partner to the Indian Cement Industry. PEG S.A. offers its services for customized and successful solutions for all projects.