ELCOGAS
Operating Experiences of the Dust Removal System
INDEX

A. Plant Overview
   - Background
   - Process Diagram
   - Operational Data

B. Fly Ash Filters. Former Design
   - Description
   - Operation Performance
   - Main Problems & Findings
   - Test Done

C. Fly Ash Filters. New Design
   - Description
   - Operation Performance
INDEX

A. Plant Overview
   - Background
   - Process Diagram
   - Operational Data

B. Fly Ash Filters. Former Design
   - Description
   - Operation Performance
   - Main Problems & Findings
   - Test Done

C. Fly Ash Filters. New Design
   - Description
   - Operation Performance
European company established in April 1992 to undertake the planning, construction, management and operation of a 335 MWe$_{\text{ISO}}$ IGCC plant located in Puertollano (Spain)
Process description

Coal preparation

HP Boiler

MP Boiler

Gasifier

Coal - N₂

PetCoke

Limestone

Flue gas to stack

Steam

Recovery

Steam Generator

Heat

G

GAS TURBINE

200 MW_ISO

CoS

HP Steam

MP Steam

Waste N₂

Fly ash

Clean

Syngas

Tail Gas

Claus Gas

Sulfur

Recovery

Sulfur

(recovery of 99.8%)

Water

to treatment

Air

O₂

Air Separation Unit

Compressed air

Flue gas to stack

Cooling tower

Condenser

GAS TURBINE

135 MW_ISO

Steam

Cooling tower

Condenser

N₂

O₂

Quench Gas

Sulfur (recovery of 99.8%)

Tail Gas

Clean Syngas

Water to treatment

Air

O₂

N₂
1st 5 years: Learning curve

2003: Major overhaul Gas Turbine findings

2004 & 2005: Gas turbine main generation transformer isolation fault

2006: Gas turbine major overhaul & candle fly ash filters crisis

2007 & 2008: ASU WN₂ compressor coupling fault and repair MAN TURBO

2010: No operation due to non-profitable electricity price (30-40 days).

2011: 100,000 EOH Major Overhaul

2012: 1,498 hours in stand-by due to regulatory restrictions

2013: More than 5,000 hours in stand-by due to regulatory restrictions
INDEX

A. Plant Overview
- Background
- Process Diagram
- Operational Data

B. Fly Ash Filters. Former Design
- Description
- Operation Performance
- Main Problems & Findings
- Test Done

C. Fly Ash Filters. New Design
- Description
- Operation Performance
Fly Ash Filters
Former Design

- Design by Lurgi Lentjes Babcock
- Filtration media: ceramic candles
- 2 vessels with 1036 candles each
- 14 groups of 74 candles in 2 levels
- Dia-Schumalith F40 candles (1.5m)
- Total surface: 269.36 m²
- Blowback gas: N₂ (50 bar, 220°C)
- Isolation valves for each group
- 8,000 operating hours expected
- 300 mbar max dP expected
Fly Ash Filters
Former Design
Fly Ash Filters
Former Design

Filters burdened on the top by a counterweight

Candles just stand on counterseal
Fly Ash Filters
Operation Performance. First Use.

Fouling Factor

IGCC operation hours

NOTA:
SET 1 en primer ciclo (ab 00-jul 01)
acumuló 5141 h (datos de fouling no disponibles)
Fly Ash Filters
Operation Performance. Cleaned Candles

Fouling factor

Set 1 (Oct03-Ene04)
Set 2 (May04-Jul04)
Set 3 (May06-Jul06)
Set 3y4 (Jul06-Ago06)
Set 6 (Ene09-Abr09)
Set 8 (Jul10-Oct10)

- Hours of operation
- Fouling factor
- Fly Ash Filters
- Operation Performance. Cleaned Candles
Fly Ash Filters
Problems & Findings

Wrong Design: Movement of candles during operation

Fly Ash Bypass

Internal ceramic filters fouling

Pressure drop increase
Candle filter life reduction
Maintenance cost increase
Plant availability reduction
Problems & Findings

RAW GAS SIDE

RAW GAS SIDE

Raw Gas

fly ash

fly ash

CANDLE

CLEAN SIDE

Clean Gas

Raw Gas
Problems & Findings

CANDLE

N₂
Problems & Findings

Ceramic candle section

Ceramic candle section
Candle filter cross section (SEM, x125)

- Fly ash over external surface (membrane)
- Body support
- Ceramic grains free of fly ash
- Body support
- Fly ash between ceramic grains
Problems & Findings

Displaced candles
Problems & Findings

Damaged candle seats
Problems & Findings

Broken candles
Problems & Findings

Clean side plugged
Problems & Findings

Candle seats blowed
Problems & Findings

Piping Mechanical failure
Tests Done

Metallic Candles
Tests Done

Metallic Candles
Tests Done

Rigid seats
Tests Done

Rigid seats
Fly Ash Filters

Change of system to Pall-Schumacher system during 2011 Overhaul
INDEX

A. Plant Overview
   - Background
   - Process Diagram
   - Operational Data

B. Fly Ash Filters. Former Design
   - Description
   - Operation Performance
   - Main Problems & Findings
   - Test Done

C. Fly Ash Filters. New Design
   - Description
   - Operation Performance
Fly Ash Filters
New Design

- Design by Pall
- Filtration media: ceramic candles
- 2 vessels with 756 candles each
- 18 clusters of 42 candles
- Dia-Schumalith 10-20 candles (2m)
- Total surface: 277.22 m²
- Blowback gas: N₂ (48 bar, 220°C)
- No isolation valves for clusters
- 8,000 operating hours guaranteed
- >10,000 operating hours expected
- 350 mbar max dP expected
Fly Ash Filters
New Design

Sección B:
Master Tube Sheet

Venturi
Fly Ash Filters
New Design
Fly Ash Filters
Operation Performance

![Graph showing operation performance of fly ash filters](image)
ELCOGAS
Operating Experiences of the Dust Removal System