REQUIREMENTS FOR THE LAYOUT & DESIGN OF COAL PREPARATION PLANTS

BY

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Branch of DMT GmbH & Co. KG - Member of TÜV NORD Group
Brief Biography

• Michael Loos Executive Director of DMT Consulting GmbH
• Processing Engineer by passion & education
• Working for more than 37 years in processing & beneficiation
  • 8 years as design engineer
  • 10 years as general manager of 7 mtpy coking coal preparation plant
• Almost 20 years as international Consultant
Coal Preparation is no rocket science....
.....but needs particular experience!!!

DMT Consulting GmbH based in the Centre of the German Hard Coal Industry has a proven track record in Coal Processing & Beneficiation for more than 100 years
Basic reasons for Coal Preparation

• Adjustments of ROM coal to market requirements
• Homogenisation of the fluctuation in mine production
• Improvement of the coal quality by means of:
  • Ash reduction
  • Increase of calorific value
  • Decrease of sulphur content
• Sizing according to market requirements
• Reduction of transport capacities
Why is the demand for CPPs increasing?

A quick view to the global coal market will bring (hopefully) some clarity.
**worldwide** appr. 6 billion t/a bituminous, subbituminous, anthracite in 2009

35% washed

65% unwashed, directly sold to consumers

Washeries (2.1 billion t/a = 100%)

- 15% < 1mm
- 85% > 1mm

7% dewatered only

- Flotation ~ 5%
- Spirals ~ 2%
- Others ~ 1%

HMS ~ 70%

- Jigs ~ 25%
- Others ~ 5%

Trend

Trend

ESSEN, GERMANY @FEB. 2015
Reasons for increasing demand of CPPs

- higher quality requirements from off-takers in the main markets power generation and coke making
- climate discussion
- increasing efficiencies in power plant technology requires beneficiated coal (low ash)
- Legal regulations in certain countries (e.g. Indonesia, India)
What is impacting the layout & design of CPPs?

- Market Requirements
- ROM Coal Quality
- Dilution (Rock Content)
- Annual Capacity
- Availability of Water
Requirements for the Development of Optimised Flow Sheet:

- ROM Coal Analyses based on representative samples:
  - Ultimate and Proximate Analyses of ROM coal sample
  - Screen Ash Sulfur Analysis of expected ROM coal
  - Float Sink Analyses of different grain size ranges
    - 120 – 20 mm
    - 20 – 2 mm
    - 2 - 0.5 mm
    - 0.5 – 0.1 mm
    - < 0.1 mm

- Coking properties of floats
- Various other test work
  - e.g. Middlings liberation
Preparation of Washability Curves
Based on analysis data from coal lab (screen ash sulfur distribution and float sink analysis) application of inhouse developed simulation software.

- The software is based on so called „Tromp’sche Distribution Numbers“ allowing to predict separation results with high accuracy for yields and qualities.
- For each grain size range all applicable technologies will be simulated and most appropriate technology will be selected.
Comparison of different flow sheet alternatives

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Rejects</th>
<th>Clean Coal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield%</td>
<td>Ash%</td>
</tr>
<tr>
<td>1 Russian Standard</td>
<td>8,37</td>
<td>74,25</td>
</tr>
<tr>
<td>2 German Standard</td>
<td>8,01</td>
<td>76,94</td>
</tr>
<tr>
<td>3 Extended German Standard</td>
<td>7,98</td>
<td>76,00</td>
</tr>
<tr>
<td>4 Larcodems</td>
<td>7,94</td>
<td>77,00</td>
</tr>
<tr>
<td>5 All Size Jig</td>
<td>8,27</td>
<td>74,10</td>
</tr>
</tbody>
</table>

![Graph showing comparison of different flow sheet alternatives](image-url)
Decision Making for Basic Process Variants

Knockout Criteria for decision between ... 
- cut point < 1.4 or cut point > 1.9 g/cm³
- feed is lignite
- gangue is clay
- feed is coking coal
- feed is steam coal
- plant manager native English speaker

Tendency Criteria for decision between ... 
- unstable power supply
- source of magnetite nearby
- skill of operators
  - high
  - low

JIG detailed feasibility
HMS
As a result of the computer simulation detailed process flow diagramm is designed providing information with regard to:

- Mass flows
- Density and bulk density
- Ash content
- Sulfur content
- Solid concentration and/or moisture content
- Water volume or pulp volume

- PFD will be designed for nominal capacity and max capacity
- PFD for design capacity will be fully balancable
- PFD will form the basis for the later visualisation of the process
- Preparation of basic design figures and design freeze
- Based on the detailed PFD CPP will be designed. Basic design work will comprise of:
  - Layout and sizing of main equipment
  - Determination of drive forces
  - Specification of mechanical equipment for tendering or budget quotes
  - General arrangement drawings applying AutoCad in a certain scale (1:100) including all required longitudinal and cross sections as well as floor plans
  - AutoCad will be able to show plant in 3D
  - Preparation of P&I diagrams showing all monitoring & control equipment as well as automation and regulation loops
  - Preparation of preliminary electrical consumer lists required for the design of power supply and distribution system
  - Specs of electrical equipment for tendering or budget quotes
  - Preparation of Materials Take Off (Bill of Quantities) for
    - Mechanical items
    - Electrical items
    - CSA (Civil, Structural and Architectural items)
  - Calculation of Engineering Hours assuming EPC(M)
- **Capex Estimate based on**
  - Budget proposals for major equipment items CIF site but excluding customs duties & levies
  - Calculation of engineering hours for EPC(M)
  - Bill of quantities and agreed unit prices for before mentioned items
  - Basic spares
  - Contingencies (FS: = 20%; BD=10% DD=5%)

- **Opex Estimate (cash cost) based on**
  - Labour cost
  - Energy (power, water, gas, steam etc)
  - Consumables (agents, flocculants, grease, oils etc)
  - Maintenance (empric figure of RAG CPPs)
    - 6%/year of mechanical investment
    - 1,5%/year of electrical investment
    - 0,5%/y of civil & structural
Engineering Set Up CPPs

- **Operational Know How:** DMT based on 150 years of coking and steam coal beneficiation in the Ruhr Valley and numerous projects abroad

- **Process Know How:** DMT

- **Engineering Supervision:** DMT

- **EPC Tender Design:** DMT
- Geology & Orebody Modelling
- Resource/Reserve Estimates compliant to JORC or NI 43-101
- Bankable Studies
- Engineering
  - Mine Design
  - Process Design
- Project Management
  - Environmental & Social Impact Assessments
- Rehabilitation of Mine Sites
- Investors' Reports
  - Due Diligence
  - Mineral Expert Report
  - Project Valuations
- Management Assistance during Operation
I would like to close this presentation with a poem of Günter Nehm a famous German Coal Processing Specialist.

“Der Aufbereiter ist nicht dumm
Er optimiert das Optimum
Denn wo die Streuung ist am schmalsten
Ist Optimum am optimalsten”

“The process guys they are not rum
They optimize the optimum
However, where the dispersion is that small
The optimum is optimal”

Thank you very much for your attention
DMT Consulting would be pleased to staying at your services