Standardised plant technology for energetic recovery of residual materials; influencing variables for optimal design and operation tailored to market requirements.

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Summary

The optimal design for an energy supply plant orientates itself to economic characteristic values, i.e. personnel and operating costs, maintenance costs and debt service. Orientation to only one criterion, e.g. lowest possible investment costs, is doomed to fail. Optimal design starts with the choice of plant's concept, which influences its economic success taking into account all coefficients. Here, plant availability is of decisive importance. The boiler design and steam parameters have a significant impact on availability.

Today, STANDARDS, i.e. pre-designed solutions, offer the possibility of realising ambitious projects tailored to market requirements in more economic time realisation schedules and cost frameworks. Available know-how reduces risks, offers planning security and leaves the necessary excess capacity to concentrate on the location and project-specific issues. These are the best conditions for the realization of innovative ideas. The plant's supplier, with his extensive market experience, suggests himself as a partner in the project realisation.

INTRODUCTION

BAUMGARTE (BBS) has been active for about 50 years with special know-how in the field of energetic recovery from residual materials. In line with the latest trends in the disposal market, communal disposal works have become energy service providers. Throughout Europe industrial clients, especially energy-intensive industries are discovering substitute fuels (RDF) as an economic alternative to fossil fuels. Substitute fuels (RDF), pre-treated residues from industrial and household waste, conceal energetic potential which today can comprise a good replacement as base load fuel. The resulting displacement of fossil fuels and their negative effects on the world climate are a positive effect.

For the manufacture of their products, industrial clients need energy in the form of electricity and/or steam. BBSs' STAVENHAGEN [1] plant has reliably supplied a foods manufacturer with steam and electricity made of substitute fuels since early 2007. At the BERNBURG [2] site, 3 lines each of 70 MW thermal combustion capacity ensure energy supply for a pharmaceuticals and chemicals company. The Elbe power plant STADE [3] will in future provide steam from a RDF- combustion plant to a Bio-Ethanol plant, and the WEENER [4] steam power plant already supplies a paper factory with process steam. Secure supply of their processes is important to our clients so that a mature and reliable technology will be used. Our experiences with the substitute fuel "RDF" give them the necessary security.

STANDARD SOLUTION, Advantages for Clients and Manufacturers

From their first planning stages "standard solutions" can provide the necessary orientation. All significant information are made available early; moreover its quality is such that no surprises may be expected later. All project participants have major planning security. Even during planning for permission, all relevant information can be inputted in execution quality. The overall planning is therefore based on real plant data and experiences and not on theoretically and expected performance.

Features specific to the respective location can thereby not only be easily integrated; one can even pay greater attention to them thereby making the project's success even more certain.

At a time when engineering resources are becoming increasingly scarce, the STANDARD is the right way to solve this problem. Both sub-suppliers and partners feel its positive effects equally.

Plants whose significant construction features are identical reduce potential risk factors, not only at the manufacturer but also at the future operator. As we know, the risks range from simple construction defects to the failure of entire systems for such complex projects. The performance limitation or delayed operability that follows such faults affects the client as much as the manufacturer, who cannot provide compensation for the commercial effects.

Precisely when handling non-homogeneous fuels, experience plays a significant role, and in many cases it is the key to the project's success. When experiences are available in an optimal (so-called 1:1) ratio, realisation is made much easier.
Significant conceptual decisions can be reflected against the reality. Maintenance concepts, for example, become transparent by virtue of the fact that it have already been tried out on a real object so the client is able to set the course correspondingly, early in his planning.
Bank financed projects are easier to realize on the basis of a "solid" reference.

Influencing Variables for the Design

The purpose of the plant's later use, i.e. the client's requirement, is the basic deciding factor, and all additional parameters orientate themselves to this.
In our studies for the OOSTENDE [5] Project, which is planned as a pure power generating station, we were able to directly substantiate the influence of the plant's size on the profitability. Though the plant tender to called for a plant with 35MW thermal output, economic framework data provided by our client ELECTRAWINDS S.A showed that a 70 MWth unit was even more profitable. An even larger plant would have been even more attractive, but the available fuel quantity limited further optimization. It is no coincidence that in recent years increasingly bigger projects have been initiated, e.g. the swb MKK Bremen [6] plant with 110 MW thermal output, or the many 70 MWth plants that are presently under construction. Smaller plants are becoming increasingly rare on project lists.
Operating costs, especially those from fuel revenues, have the greatest influence on the profitable operation of the plant. The choice of components with an eye on later operation regime, consumption figures, maintenance requirements and the accruing operating costs lead directly to the goal of optimizing the plant's operation. A higher initial investment can be good investment over the plant's lifetime.
The material flows to be disposed of must be established and be considered differently from a state-specific point of view during determination of the plant's concept. Thus, investment in separate storage of the boiler ash and filtration is worthwhile if these can be disposed of at different prices. Waste gas purification by quenching may be advantageous compared to other methods if the location is likely to have high wastewater fees and apart from that there is equal value. There are many examples of this type. Hence a holistic observation of the system and adherence to economic criteria are indispensable.
The plant concept is substantially influenced by requirements of availability of power and steam supply. Thus at the Bern burg site, three combustion lines are being installed in order to guarantee steam delivery to the consumer with adequate reliability.
Availability is the key to economic (1), to optimal operation and hence to project success. Plants with high steam parameters often pay for the advantage of better efficiency with higher failure rates due to corrosion damages. Even with a reduced annual operating time of about 3 days, the advantage of an approx. 1% higher electrical output would be compensated.
"For an exemplary plant, 85% of whose revenue comes from waste acceptance and 15% from the energy output, a measure that increased availability by 1% would have the same revenues effect as a raising of the energy efficiency by 5.7%“. (2) This observation shows the economic impact.
Here, too, the observation must cover the entire period of the plant's lifetime. The first operating year with an availability commitment by the manufacturer is not unconditionally representative for what can be anticipated in real availability after 3, 5 or 10 years. For this, the choice of steam parameters and boiler construction method are of great importance.

Optimal Boiler Design for Optimal Plant Operation

The impact of steam parameters on corrosion behaviour is sufficiently well-known. In the OOSTENDE project and all other projects of the 70 MWth class, therefore, moderate steam temperatures and pressures were selected (see List of Technical Data).
The following advantages of the so-called Tail End boiler design, i.e. the combination of vertical radiation flues gas passes and horizontally-mounted flue gas pass convection heating surfaces installed there are to be emphasized.
The advantage of this design is that steam is not necessarily required absolutely for cleaning the convection heating surfaces. The steam can be made available fully to the client, thus improving income. Abrasion phenomena, e.g. as caused by soot blowing, need not be considered in the maintenance plans and costs. Restrictions on availability due to emaciation of pipes by soot blowing or fallen protective shells are not to be considered in this design. This type of heating surface construction also proves to be economical with respect to the implementation of maintenance and

servicing. The harps are hung up individually and are easily accessible. In some cases, even the exchange of complete bundles is possible over the top of tail-end cover.
This design affects operation time positively, influences start up- and shut down costs/times, and together with the larger fuel throughput attainable it has advantageous effects on the economics of the plant operation.
The vertical radiation passes should be kept as free as possible of inserts (platen heating surfaces). These blank passes can then be washed simply by water spraying installations. This has two important effects. Since the flue gas temperature does not increase so heavily during the period between boiler cleaning, boiler efficiency remains high corresponding to the initial level. The positive influence on corrosion behaviour – which from experience proceeds less intensively at lower temperatures - appears to be even more significant.
From our point of view there is only one criterion which should deter clients choosing this design. That is space limitation which does not allow the construction of a plant with large ground space requirement, e.g. for a tail-end-design boiler. Other site factors such as compliance with special noise limit values or soil suitability do influence the building concept but not the boiler design.

Innovations on the Basis of STANDARDS

By deriving a project from an already-realized plant the aforementioned advantages and securities can also be used for further development and product improvement. Thus in the STADE Project BAUMARTE has integrated the newly-developed TETRATUBES (3). Similar in concept to the boilers at the WEENER and OOSTENDE plants, a proven boiler construction is used as the basis on which the technological adjustment for the innovative TETRATUBES rests. The installation and operation of TETRATUBES leads up to a 10% increase in the boiler's capacity. Our client, Prokon Nord GmbH, has recognized the potential for this technology and is supports us in its market introduction. The main effects in this connection are: optimized plant with reduced control deviation, reduction of temperature peaks, uniform burn-out of the flue gases, reduction of CO, reduced excess air and reduced corrosion.

Technical Data From Selected Baumgarte Reference Plants

	Location	Therm. Output	Steam Pressure	Steam Temperature	Specific Features
[1]	Stavenhagen	1 x 47.5 MWth	43 bar	400°C	
[2]	Bernburg	3 x 70 MWth	42 bar	410 °C	
[3]	Stade	1 x 70 MWth	42 bar	402 °C	TETRATUBES (3)
[4]	Weener	1 x 70 MWth	27 bar	320 °C	
[5]	Oostende	1 x 70 MWth	42 bar	402 °C	
[6]	MKK Bremen	1 x 110 MWth	40 bar	400 °C	

Bibliography:

(1) Günther, Dr. Johannes (2008), Energetic Recovery from Wastes, Energy from Waste Vol. 4, Neuruppin, TK Verlag
(2) Bette, Matthias, (2008), Overview of Measures to Improve the Availability and Travel Time, Energy from Waste Vol. 4, Neuruppin, TK Verlag
(3) TETRATUBES Patent No.: DE 10 2004 004 853 A1