ENERGY CONSERVATION – AIR POLLUTION ABATEMENT PROJECT

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OPSOMMING:

Die aanvanklike vereiste was om aan die Lugbesoedelingwet te voldoen. Na die ontstaan van die oliekrisis het dit ontwikkel in metodes om die afval hitte wat verkry is deur die verbranding van die besoedelgasse te gebruik om stoom en elektrisiteit op te wek en die eindprodukte optimaal te benut om sodoende finansiële besparing mee te bring.

SYNOPSIS:

The initial requirement was to comply with the Air Pollution Act, this developed after the oil crisis descended on the world into methods of utilising the waste heat obtained in incinerating the offending gasses (i.e. the Air Pollution Abatement aspect) to the best financial advantage by generating steam/electricity and utilising the final products to best advantage.

The Original Problem – Air Pollution Abatement – In 1970 when considering adding another carbon black line to the plant, the Chief Air Pollution Control Officer advised that because of the amount of H_2S and SO_2 gases that would be released into the atmosphere from three carbon black plants, the plant would have to ensure that the gases were incinerated before the combusted gases were discharged into the atmosphere at a height of 50M above ground level with an exit velocity of 15M/sec. He allowed five years to progressively comply with this requirement.

Change in Emphasis – As things turned out with many delays and eventual disabandment of the project by the original incinerator contractor, due to their lack of expertise, the whole project took on a new turn as by then the Energy crunch had descended on the world. This required a reappraisal of the incineration aspect and reopened a steam/electricity generation project which had lain dormant since 1967. At that time the calorific value of the gas was ± 350 k.Cal/Nm^3 and the project did not appear to be a viable proposition. Since then other changes on the carbon black plants have had the effect of increasing the calorific value to ± 700 k.cal/Nm^3 and, of course, with three carbon black plants on stream the total quantity of gases available had increased considerably.

End Result – The opportunity thus arose whereby not only would we comply with the Chief Air Pollution Control Officer's requirements in incenerating the gases – but we would also be able to generate 65 tonnes/hr. of medium pressure steam, produce 10MW of electrical power via a back pressure turbine, have sufficient exhaust steam available for process purposes and enough to sell to a neighbouring industry. The electricity generated would be sufficient for the carbon plants use as well as the neighbouring industry – and all from the necessity of eliminating the H_2S in our effluent gases.

Investigation into Potential – There are three plants capable of producing eleven grades of carbon black all at different rates, with off-gas (as the effluent gases are called) of varying calorific values. The carbon black is produced in powder form, but is densified in a wet pelleting process – the water has to be evaporated in large driers – fired by this off-gas in specially designed combustion chambers – which in turn require different quantities of gas because of the varying difficulty of drying the different grades – each type of black has its own drying characteristic. Thus the permutation of available heat for steam generation is considerable.

Initially it is essential to design for the maximum H_2S and SO_2 – because it is possible that you could have this combination and under the Air Pollution Control Officer's directive it has all to be incinerated. This then would contol the size of the facility required – and hence the capital cost.

It was also necessary to decide what would "average" operating conditions be, because this would determine the income possibilities.

Sales projections had to be made up till 1988 for the various grades of carbon black. Using this information it was possible to predict the amount of steam which would be available at each year. This was necessary to enable income calculations to be made with reasonable accuracy.

Governmental Assistance for Energy Conservation Projects

At this stage it is necessary to point out that the energy available is equivalent to that obtainable from 30 train loads of coal (of 1 800 Tonnes each) which are being brought from the coal fields to Port Elizabeth every year!

The diesoline used by these trains is in the region of 250 000 litres/annum (part of the way the line is electrified).

Supplying low pressure steam to a neighbouring industry will save them 9 000 000 litres/annum of furnace oil, whilst if medium pressure steam is produced it would be possible to supply steam at 2 760 kPa to Fish Water Flats Water

Reclamation Plant – saving their operation 1 250 000 litres/annum diesoline.

An approach was made for assistance from the Minister of Finance – but this was refused.

At the same time the Minister of Planning and the Minister of Economic Affairs were requested to consider some form of assistance with minimum interest being shown. This was done after the initial budgetting investigation had been completed – which showed very clearly that the generation and sale of low pressure steam was a feasible proposition. However the incremented expenditure for a medium pressure boiler/turbo-alternator set producing sufficient electricity for our use and sale to the local authority did not warrant the minimal increase in income from the local City Council – due to them only being prepared to pay the equivalent of their coal costs.

It was later found that under the Electricity Act it is permissable to generate electricity for your own use and for sale to one other party – with the necessary permit or licence as the case may be from the Electricity Control Board.

The Act goes on to say that permission may not be unreasonably withheld. If it is considered that the latter is the case, a public hearing may be requested.

During the tendering period the Electricity Control Board were asked if they would permit the sale of electricity to the same neighbour to whom it was intended to sell steam – the Secretary replied that in view of the energy conservation involved they would look on such a request very favourably.

Under the regulations of the Act, when approaching the Control Board, it was necessary to advise the local authority that such permission was being requested. The local City Council have just taken a decision stating that they would object to such permission being granted; and that at a time when the Cabinet is doing all it can to encourage and ensure that energy conservation is practised to the ultimate degree commensurate with the overall economic position.

The Crux of the Problem – It is easy to say that the gas must be incinerated, but to burn it without using supplementary fuel, that's a different story. Not only is it of very low calorific value but the water content in the gas is 40%, which adds to the problem. Virtually every boiler manufacturer believes he has the answer to all combustion problems – but once presented with the gas analysis and being asked to guarantee that complete combustion will be achieved without the use of supplementary fuel, they soon decide that this is a project they had better leave well alone.

A considerable amount of enquiry was conducted in order to establish what carbon black plants around the world were in fact burning their "off-gasses" and whether this was being carried out in incinerators or boilers and with what results. Facilities were inspected in carbon black plants in France, Germany, Holland, Sweden, Italy, England and the United States of America. Two paramount facts emerged – these were that it was necessary to have an inordinately large combustion chamber, allowing a longer than normal residence time to incinerate up to 5 gms/Nm^3 of carbon black, and with the air and gases coming in virtually tangentially to provide a swirl and thus obtain effective mixing of the gasses.

As far as could be ascertained there appeard to be only two possible suppliers – one German and the other French.

Tendering Procedure – Eventually tenders were called for:-

(1) Off-gas incineration only;
(2) Off-gas incinerator and low pressure boiler;
(3) Off-gas incinerator, medium pressure boiler and turbo-alternator set to generate electricity for in-plant use only;
(4) Off-gas incinerator, a medium pressure boiler designed to produce the maximum amount of steam from the ultimate available quantity of off-gas, and a turbo-alternator designed to produce the maximum amount of electricity – from the steam available.

This was necessary as viability studies would have to be made of each possible route to determine the shortest pay back period. This would probably determine the plant to be ordered, which could be unfortunate for the country, because it might mean that considerable amounts of energy in the form of heat would by-pass the boiler tube section and be sent straight up the stack. The design and layout of the various proposals offered had to ensure that this could be done as all the off-gass had to be burnt.

THE ENERGY BUDGET

A. *Demands in the Plant* – 5 Tonnes/hr. at 10 bars as process steam for in plant use.

B. *Possible Further Demands* –

(1) Selling on average 17 Tonnes/hr. of steam at 10 bars to a neighbour – which could peak to 25 Tonnes/hr. for start-up;
(2) Selling of 5 Tonnes/hr. of steam at 27,6 bars to the neighbouring Water Reclamation Plant;
(3) Generating 5MW of electricity for in plant use;
(4) Generating 10MW of electricity, which would be sufficient for in plant use and enable 5 MW to be sold to the same industry which would take the low pressure steam.

Assuming that the 5 Tonnes/hr. of steam for the Water Reclamation Plant is taken off at the pressure produced by the boiler before the balance of the steam enters the turbine, then the power which can be obtained under the various

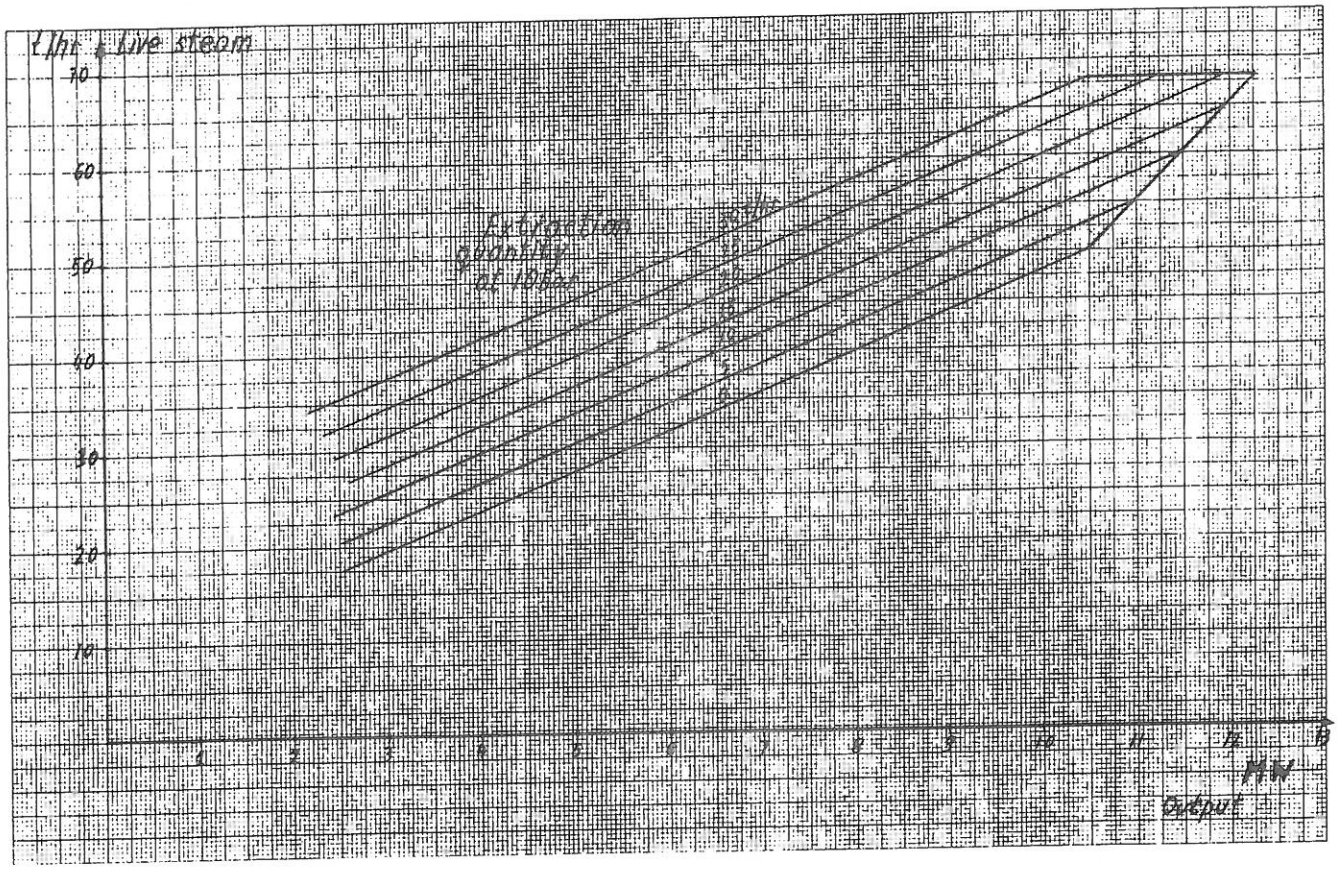

FIGURE 1

producing conditions (depending on the carbon black sales for the year) and the various possible steam demands at 10 bars, can be determined from the curves on the graph. Figure 1.

From this the following table was drawn up:-

Extraction at 10 bar 25t/hr

	Live Steam t/hr	Electrical Output MW
1980	44	5,35
1981	46	5,70
1982	48	6,30
1983	51	7,05
1984	54	7,75
1985	56	8,25
1986	59	9,0
1987	62	9,75
1988	65	10,5

Viability Consideration – The ability of many concerns to save energy or to utilise existing unusable energy sources by converting them to a usable type of energy depends to a large extent on the financial return that can be obtained or any expenditure incurred. This may be looked at in abso lute terms or relative to alternative expenditures also yield ing a financial return.

In a country such as ours, that is so dependant on the im portation of large quantities of oil, insufficient attentio is being given by the Government to ways of encouragin industry to invest in energy saving or energy conversion ca pital equipment. The present tax allowances of 30% invest ment allowance and 25% initial allowance do to some ex tent provide a cash benefit to companies investing in capi tal plant used in the manufacturing process. Capital exper diture of this type is normally incurred to develop the pa ticular company's main area of operation. Investment i energy saving projects or energy generation projects will i the main cover subsidiary areas and consequently whil having a bearing on the profitability of a company may nc be essential for the company to continue its existing bus ness.

If one considers the utilisation of existing energy sourc that are wasted and which could be converted to energ in a usable form, the economics of scale of the operatio will normally be such that the capital cost related to v

lume of energy produced is too great to be a viable proposition. This has been recognised by many countries throughout the world whose self sufficiency is greater than ours and actual cash grants or special tax incentive schemes have been launched to encourage industry to invest in energy conservation and generation programmes.

South Africa can not only afford to allocate funds for this type of incentive but should have done so back in 1973 when the energy crisis first became apparent. Without considering the rate of incentive that should be offered one should consider the benefits that will accrue to the fisces.

A company will elect to invest in energy conservation if the investment reduces energy costs or generates energy at a return on the investment that is acceptable to it. If it does invest it initially provides additional manufacturing requirements for other South African industry which will generate income to the fisces in the form of sales tax. It would normally increase the profits of the supplying companies which in turn would provide additional company tax. Depending on the equipment required it could provide additional employment with the consequent accrual of individual tax to the revenue authorities. Should equipment have to be imported, revenue is earned from duties and the $7\frac{1}{2}\%$ import surcharge. The company investing in energy conservation equipment will in turn generate additional profit on which tax would be due.

The country as a whole could save foreign exchange as a result of the reduction in energy consumption and consequent reduction of oil imports. The extent of the saving initially would depend on the value of equipment that might need to be imported.

So far everything has been in favour of the fisces if investment takes place. Surely then some additional incentive is warranted in order to encourage this investment and so start the ball rolling.

If one considers an additional incentive of 30% equal to the investment allowance this could make the difference between investing or not investing. At present rates of inflation a DCF rate of return after tax of 15% can hardly be considered exciting but this could increase to 19% with the additional cash flow being generated by tax savings in the first year of operation as a result of additional incentives. In applying allowances granted by other countries to investments in South Africa the rate of return on the investment could increase by between 20% and 30% which in many cases would be sufficient to tip the scales in favour of the investment. Naturally the degree to which additional incentives will assist companies to achieve an acceptable rate of return will vary depending on the ratio of expenditure on capital to that on labour but generally projects of this nature tend to be capital intensive.

Other Governments' Viewpoints – Japan set up an Advisory Committee for Engergy, under the Ministry of International Trade & Industry. They decided to help Industry by offering financial grants and tax privileges to private firms developing energy saving technologies.

Sweden has a State Energy Conservation Committee which oversees loans and grants for industrial conservation projects. *The Government is aware that industry will not undertake a project on its own where the savings will not justify the investment.* So far it has given R25 million for projects expected to save 200 000 tons of oil per year. They granted 50% of investment costs up until July 1979; it is now 35%.

France as early as 1974 set up the Agence pour les Economics d' Energie under the Ministry of Industry & Research. Subsidies of up to 50% of the costs are granted to plants that install energy-saving equipment. In return, the company must publicize the progress of the project and allow competitors to inspect it.

United Kingdom has an Engergy Conservation scheme set up under the Department of Industry who make grants available after consideration of application which must be backed up by an appraisal from Consultants acceptable to the Department. 50% of the Consultants' fees will be refunded by the Department. Assistance is in the form of a capital grant of an amount to be negotiated. The Department has to be satisfied that in the absence of assistance the project would not otherwise go ahead in the form proposed, or within a reasonable timescale.

Our own position – At this stage our Government provides no additional incentives for thsese co-generation energy conservation projects and it would seem most likely that a considerable amount of heat (energy) will bypass the boiler and be discharged into the atmosphere. This will in effect mean

(1) That those 30 train loads of coal will be brought from the coal fields to Port Elizabeth annually unnecessarily;
(2) The South African Railways will thereby waste 250 000 litres of dieselene annually;
(3) The Port Elizabeth City Council will use 1 250 000 litres of dieselene unnecessarily at their Water Reclamation Plant.

How long can our country go on in this way – we appeal to the Government to look more thoroughly into Energy Conservation projects than they appear to be doing at present.