EUROMOT POSITION

20 Nov 2014

Euromot Response to CEFIC Comments as of 17 July 2014

A. General

For many years, Euromot has been one of the major stakeholders in the European and international regulatory processes, such as UNECE and IMO, where we contribute substantially to the evaluation of new emission reduction technology for combustion engines and provide our expertise to regulators and authorities. We welcome therefore new developments in the technical field including the assessment of new BAT techniques for emission reductions.

To provide the highest environmental, economic and social benefits for society, **we believe that any technology that is regarded BAT has to demonstrate it is technically and economically feasible** (for a definition of BAT we refer to the preface of current LCP BREF 2006 /1/). In our opinion the Maltese Delimara plant has not yet proven it is representing BAT.

Most of the proposed BAT emission limits (namely NOx, SO_2 and dust) in the LCP BREF 2013 June update document for a HFO (Heavy Fuel Oil) fired stationary diesel engine power plant are based on emission information from the Enemalta combined cycle diesel engine plant. Malta offered this plant as a **<u>case study</u>** (questionnaire in BATIS dated November 2012 states: " *.. Note: The Combined Cycle Diesel Engine plant which is being proposed as a* ***'Case Study' is currently during its testing and commissioning phase.*** *Data submitted in this questionnaire is based on design values or operating data during a* ***one month Reliability Test in September 2012*** *and* ***not on a full reference year***").

Following information raises also big doubts for the grounds to have this plant as a BAT reference. In the "… *updated questionnaire to cover the whole year 2013*" inserted into the EIPPCB BATIS database by Malta in April 2014 it is stated: *"Conversion of the engines to dual fuel (gas or liquid fuel) is planned in 2015 due to planned availability of natural gas (LNG) in mid 2015."* Thus there is a risk **risk that sufficient long operational period hours of this FGD (Flue Gas Desulphurisation) technology will not be reached** (needed in order to see “normal” long term operation of this technology), for further information, see our June 2014 Presentation material.

Despite this the information was used when setting BAT AEL:s for above mentioned pollutants. Euromot has given feedback on the “2012 reported plant emission values” and concluded why this **cannot** be considered to be a BAT approach earlier in Position Paper “LCP BREF BAT-AELs for HFO-fired engines available at http://www.euromot.org/download/54383683de278fdcb4d093b1.

Euromot made in June 2014 presentation slides based on the “…*updated questionnaire to cover the whole year 2013*” inserted into the BATIS database by Malta in April 2014 showing that the stationary engine industry **still does not consider** this plant to be a BAT candidate plant. These slides were inserted into BATIS for the interim TWG meeting in June.

In July 2014 CEFIC (Mr. P. Cassaghi) sent in a reply to the Euromot submitted material. In below text we have given our feedback item per item on the CEFIC response letter dated 17.07-14, **which in our opinion contains misleading and incorrect information.**

B. Response to the CEFIC comments by Mr. P. Cassaghi dated 17 July 2014

(1) CEFIC Statement

CEFIC remarks are highlighted in yellow below:

Page 2:

“Novel Dry FGD used in Maltese case study, see ANNEX 1
– No long-term experience exists.”

Dry Bicarbonate FGD has been implemented for 25 years in. Hundreds of references exist worldwide nowadays. Many of them operate in similar conditions of pollutants and temperature. The technic has already been referenced in current BREF LCP issued in 2006 based on data collected in 2003.

Euromot response (to above CEFIC statement in yellow)

We agree that dry bicarbonate FGD is a well-known and well used technology in context with (smaller) boiler and waste incinerator plants /9/. Many references delivered by several companies can be found on these kind of applications**.** However, CEFIC did not take into account that our presentation material sent to the LCP BREF update June 2014 Interim TWG meeting **was targeting stationary diesel engine plants**. Diesel engine and boiler flue gases are substantially different which e.g. LCP BREF 2006 /1/ document in chapter 6.1.10.3.1 also notes:

particulates is currently under development for larger diesel engines. Due to the different temperature and oxygen content of the diesel flue-gas, the electrical properties of the diesel particulates (e.g. resistivity, etc.) are different compared to particulates from a boiler flue-gas, and proper testing of the ESP (electrical precipitator) is needed prior to commercial release.

Hence, operational experience from boiler plants **cannot be directly applied** on diesel engine based plants without proper testing. A dry FGD process shall besides SO_2 also reduce particulate emissions.

In chapter 3.3.5.2 of the LCP BREF 2006 /1/ the dry bicarbonate FGD process is described as an emerging technology for (old) **small boiler** plants.

Euromot is not aware at all of any bigger HFO fired stationary diesel engine plant with long term experience with the dry bicarbonate FGD and thus we maintain our position that it is too early yet to base SO_2 and particulate emission BAT limits on this technology.

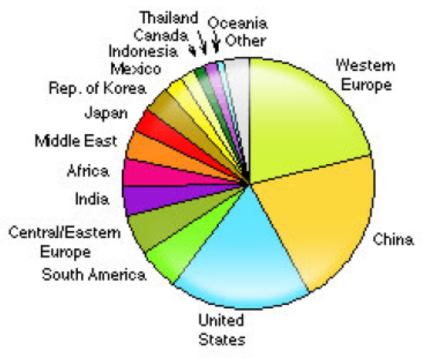
Conclusion:
We maintain our Position that the dry bicarbonate FGD is not BAT for a (bigger) liquid fired stationary engine plant.

(2) CEFIC Statement

"A special infrastructure has to exist in order to apply dry FGD
– Reagent supply infrastructure has to exist for this special reagent"

Sodium bicarbonate is available and sold everywhere in the world for many applications.

World Consumption of Sodium Bicarbonate—2012



Source: HIS http://www.ihs.com/products/chemical/planning/ceh/sodium-bicarbonate.aspx

Handling has to be done with appropriate equipment like for any other product but has the advantage to be safe for workers and easy to manipulate.

Euromot response (to above CEFIC statement in yellow)

We agree that sodium bicarbonate is in big quantities worldwide. However, HFO fired stationary diesel power plants are today in practise in Europe only in operation on islands and remote areas where the infrastructure cannot be regarded as highly developed as in Central Europe mainland. For more information about the special conditions on island (cost impact, etc.), please see the Eurelectric document /3/ chapter 2, explaining challenges with the supplies for emission reagents for a SCR to islands and subsequent disposal of end products. To note, that with a FGD system the (end product, etc.) disposal challenges are of **magnitudes greater** than for a SCR system.

In the Euromot presentation material, it was highlighted that the end product consisting mainly of Na_2SO_4 is **not stable and thus leachable** (heavy metals will leach out) in water. The produced end product cannot therefore easily be disposed like e.g. with $CaSO_4$ from a $CaCO_3$ wet scrubber FGD or $CaSO_3$ after stabilization in case of a semidry CaO FGD system. The dry bicarbonate FGD end product needs to be sent to a factory for further treatment or deposited on a certified landfill which is protected against leaching. We have understood that the Maltese Delimara plant is sending the end product abroad for treatment. This creates additional costs and requires an infrastructure which might not be the case on all islands around the European area or in distant "departments" or the various EU "outermost regions" (islands part of some EU countries).

Conclusion: We maintain our position on the infrastructure issue.

(3) CEFIC Statement

"Expensive reagent NaHCO3: Typically, 1.7 - 7 times higher reagent cost compared to the $CaCO_3$ FGD!"

Sodium bicarbonate is generally more expensive than calcium carbonate. However the capital cost for a dry sodium bicarbonate injection is 10 to 15 times less than a wet scrubber and DSI energy consumptions are much lower compared to a wet FGD.

Wet scrubber CAPEX: up to 172 USD / kW (http://www.graymont.com/sites/default/files/pdf/tech_paper/wet_flue_gas_desulfurization_technology_evaluation_0_1.pdf)

DSI CAPEX: down to 16 USD / kW (http://bipartisanpolicy.org/sites/default/files/Jim%20Staudt_0.ppt)

Euromot response (to above CEFIC statement in yellow)

In a **big power plant** (LCP BREF is for > 50 MWth plants) case (built to operate for a long operation period 10 – 20 years or a longer time depending on the specific case), the impact of the running cost - OPEX (operational expenditure) is large and focus on solely CAPEX (capital expenditure) is **not correct**. LCP BREF 2006 /1/ states also in section 3.3.5.2 "… *Dry sorbent injection processes are commercially competitive at **small** plants …*".

We took a look on above referred link (given by CEFIC) "DSI CAPEX" and noted following:
Capital cost of 16 USD/kW could be typical for a retrofit to a boiler plant **already** having a bag filter/ESP unit. **Only "*three 75 ton silos for (three full load days)*"** seems to be included in the 16 USD/kW cost i.e. only a tiny fraction of all equipment needed for a **new** plant FGD (Flue Gas Desulphurization) system.

In UNECE document /3/ in the chapter "Combustion Installations larger than 50 MW" the text above table 20 on page 87 states "…*capital cost of a dry scrubber is **30...50 %** less than the capital cost of a wet scrubber for the same size of process, but the operation costs are higher due to higher sorbent costs.*"
This statement is also close to our own experience of prices when comparing different ($NaHCO_3$, versus $CaCO_3$ based) FGD technologies.

Conclusion:
A dry $NaHCO_3$ plant investment cost is typically in order of about 50 .. 60 % of a wet $CaCO_3$ FGD (depending on scope and plant configuration). Reagent and end product disposal costs represent a big part of the OPEX. In a big plant case OPEX will have a large impact on the total cost picture and shall not be disregarded. **Thus we maintain our position.**

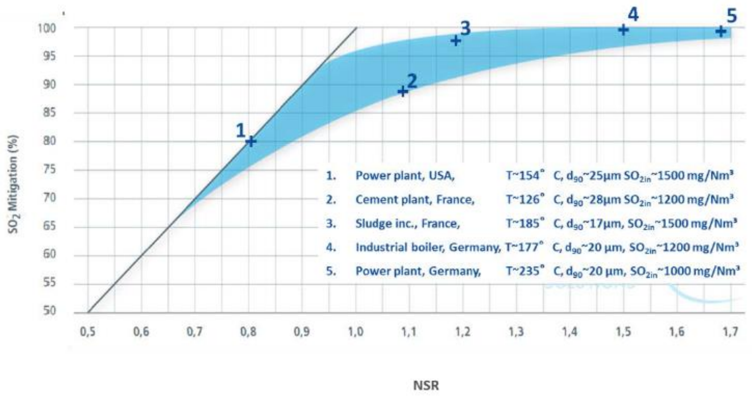
(Continued on next page)

(4) CEFIC Statement

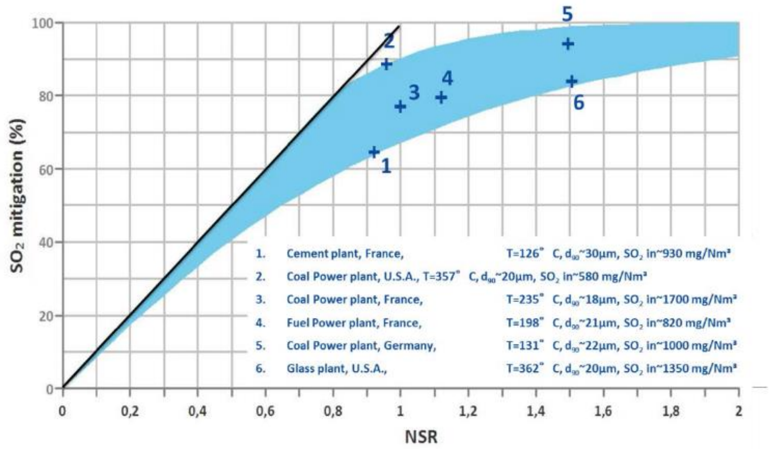
"Dry FGD is not suitable for high sulfur HFO:
– A **low sulphur HFO fuel is used** ***S < 0.7 wt-%, ash < 0.03 wt-%***
– If HFO is of high sulphur type high over stoichiometry is needed, increasing operating costs significantly."

This sentence should be supported by evidences. Experiences in other industries in similar conditions and of other power plants HFO fired demonstrate there is no need for tremendously high over stoichiometry. With a stoichiometry ratio of 1,2, it's possible to achieve a mitigation rate above 90% on ESP and above 98% on bag filter. Sodium bicarbonate injection has the great advantage to be able to treat more pollutants without further investments. On the contrary, wet scrubbers are designed one for all and not able to treat more pollutants than design once installed.

SO_2 mitigation on a bagfilter (generally observed)



SO_2 mitigation on a ESP (generally observed)



Source: CEFIC

Euromot response (to above CEFIC statement in yellow)

We are aware and agree that a dry FGD $NaHCO_3$ reagent based system can reach high SO_2 reduction rates, but the amount of reagent need (stochiometry) will then increase significantly and consequently the operation costs.

In the Delimara case a 0.7 wt-% S HFO (Heavy Fuel Oil) (equals about 400 mg/Nm3 (15 % O_2) SO_2) was used and the proposed LCP BREF SO_2 limit is < 100 mg/Nm^3 (15 % O_2). Then a

75 % SO_2 reduction should be required. With a 3.5 % wt-S HFO to reach the above same SO_2 limit an approx. 95 % reduction is needed. According to curves given by CEFIC (above): stoichiometry increases from about 0.75/0.85 to 1.2/1.55 (wide variation area in graph) when sulphur content of the HFO increases from 0.7 to 3.5 wt-% S in order to reach the in LCP BREF D1 proposed SO_2 limit → up **about 60 … 200 %.**

Conclusion:
High SO_2 reductions require reagent ($NaHCO_3$) overstochiometries in the range of 1.2 – 1.55 (or even higher in case of ESP in place of bag filter). The largest part of the FGD operating costs is the sorbent/reagent cost. At reagent overstochiometries the end product will in the $NaHCO_3$ case also contain a lot of unreacted sodium carbonate and bicarbonate. A high overstochiometry has a large impact on the OPEX.
Thus we maintain our position.

(5) CEFIC Statement

Page 3:

" **Long start-up time:**
– Bag filter needs to be pre-coated with reagent 2 - 3 hours before start-up"
Pre-coating is only necessary after a maintenance period. In normal operation bag filter has to be maintained warm and ready to start. For startup, bag filter doesn't need to be coated to mitigate acid flue gases because sodium bicarbonate has already very good mitigation efficiency in duct..

"Not suitable for peak load plants !"
As startups are very easy with bicarbonate dry sorbent injection, the process is perfectly suitable for peak load plants that have to resume quickly

" Technique cannot be applied universally as not suited to plants in cyclical operation and without flue gas cooling:"
For cyclical or continuous operations, bagfilter has to be backflushed and thus there are no significant differences between both operations. Bagfilter has proved to be an efficient and reliable technique of dedusting in all kind of industries.

"Dry FGD recommended only for continuous operating plant. !"
Same comment, see above.

a) CEFIC Statement: "Long Start –up time: Bag filters needs to be pre-coated with reagent 2-3 hours before start-up."

Euromot response (to above CEFIC statement (a))

Our statement was **due to the following risk** (not about reactivity which the answer appears to refer to) which is **also highlighted in LCP BREF D1 2013** /4/ chapter 3.2.3: " .. *Some fuels may cause clogging problems, which complicates the process operation.* ***Clogging problems*** *may occur, e.****g. during start-ups when oil*** *is burned . The filter material is usually quite sensitive* ...".

➔ There is a big risk of clogging of filters, hence special care to be taken during start-up/shut-downs.

Conclusion:
We consider our statement as correct.

b) CEFIC Statement: "Not suitable for peak load plants"

Euromot response (to above CEFIC statement (b))

- According to source /5/ containing Delimara Plant information, the Enemalta plant is in practice "almost" a base load plant and not a peak load plant:

Base load: plant/s run for 24 hours; **two-shift operation:** Plant/s run for 16 to 18 hours per day.

- In the ".. *updated questionnaire to cover the whole year 2013*" **inserted into the EIPPCB BATIS database by Malta in April 2014 it is stated**: ".. *Minor dust problems continued to occur due to filter bags leaking from tearing of bags as a result of abrasion and movement. Most of these faults are a* ***result of cyclic operation. Continuous operation could have reduced such faults...***"

  See also link (8/ stating**: "…** *In 10 months a number of generating units had to be shut down for a total of at least 1,419 hours, equivalent to nearly 60 days. The plant, commissioned in 2012, has been dogged by a series of problems, which the Energy Ministry has blamed on the complexity of the engines and the abatement system that cleans exhaust before it is released into the air. The filtering system is necessary since the diesel engines are run on heavy fuel oil that produces a lot of pollutants when burnt. But despite a reduction in faults, the ministry acknowledged Enemalta was still grappling with operational problems"*

- Due to changes in the current markets for electrical power supply with a lot (and increasing) of renewable installed electrical generation capacity there are increased demands for fast reacting peak power plants in many parts of the world including Europe. RICEs (Reciprocating Internal Combustion Engines) are well suited to be e.g. used as a "non-spinning reserve plant" , where the requirement often is to start up within < 5 minutes from 0…100 % load /7/. In source /6/ in section 4.2 for liquid fired stationary RICE typical start up and shut down times of the engines are shown. Shut down times are typically in order of 1 minute and start up times varying from 3 … 15 minutes (from 0 to 100 % engine load) depending on engine type and "readiness" (temperature) of the engine.
  A FGD installation in these kinds of peaking plants should substantially slow down these plants consequently they should not be capable of providing the fast start-up/shut-down operating profile.

Conclusion: We maintain our position.

c) ***CEFIC Statement: "Technique cannot be applied universally as not suited to plants in cyclic operation and without flue gas cooling". Dry FGD recommended only for continuous plant."***

Euromot response (to above CEFIC statement (c))

- Goretex filters /5/ → the exhaust gas temperature is to be reduced in order to protect the filter material to about *170 .. 180* degree C (which is not a problem in a boiler plant). Note that the engine flue gas temperature is typically 250 .. 400 degree C, dependent on the type of engine, thus a "proper cooling" needs to be arranged upstream a dry FGD with bagfilters.

- See also above response on operation mode suitability in item 2.

Conclusion: We maintain our position

(6) CEFIC Statement

CEFIC estimates that bicarbonate dry sorbent injection is a proven and reliable technology which allows many industries to comply with IED.

Euromot response to above CEFIC statement and and overall conclusion:

With reference to the above given feedback **we maintain our position that the dry $NaHCO_3$ FGD process is not a proven BAT for a (bigger) HFO fired stationary diesel engine power plant.**

Sources:

/1/ LCP BREF 2006 at http://eippcb.jrc.ec.europa.eu/reference/BREF/lcp_bref_0706.pdf

/2/ Eurelectric : “Emissions from diesel generation in Small Island Power Systems – Recommendations for the revision of the Gothenburgh protocol” , July 2011 at internet http://www.unece.org/fileadmin/DAM/env/documents/2011/eb/wg5/WGSR49/Informal%20docs/EURELECTRIC-disel_engines_and_Gothenburg_protocol-July_2011.pdf

/3/ UNECE Guidance document on control techniques for emissions of sulphur, NOx, VOC, dust … from stationary sources at: http://www.unece.org/fileadmin/DAM/env/documents/2012/air/Guidance_document_on_control_techniques_for_emissions_of_sulphur__NOx....pdf

/4/ LCP BREF D1 2013

/5/ “BAT Measures – New Plant Extension …” http://www.google.fi/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&uact=8&ved=0CCcQFjAA&url=http%3A%2F%2Fwww.mepa.org.mt%2Ffile.aspx%3Ff%3D6602&ei=QVdqU4PHJeaR7AatuYDYCQ&usg=AFQjCNF5Bxof1xewoh8RmRThfJhq4JjL9g

/6/ Euromot Position “LCP BREF BAT Associated Energy Efficiency Levels ..” at http://www.euromot.org/download/5453c772de27a3a6fea5ce05

/7/ http://www.optimalpowersystems.com/stuff/operating_reactive_and_black_start_reserves.pdf

/8/ http://www.timesofmalta.com/articles/view/20131120/local/Faults-are-still-dogging-power-station-engines.495446

/9/ http://www.seas.columbia.edu/earth/wtert/sofos/nawtec/nawtec18/nawtec18-3560.pdf

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EU Transparency Register ID number: 6284937371-73

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