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環境空間計画省

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事業完了報告書
別添資料

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JFE テクノリサーチ株式会社

目　　次

別添資料―１　協議議事録..1
　１－１　コンタクトミッション MOU..1
　１－２　第 1 次派遣終了時 MOU..7
　１－３　第 2 次派遣終了時 MOU..13
別添資料－２　報告会（ワークショップを含む）..17
　２－１　第 1 次派遣：ワークプラン概要説明会..17
　　２－１－１　概要..17
　　２－２－２　ワークプラン説明会資料...18
　２－２　第 1 次派遣：第１回ワークショップ..20
　　２－２－１　概要..20
　　２－２－２　ワークショップ資料（英語版）..21
　　２－２－３　ワークショップ資料（アルバニア語版）...29
　２－３　第 1 次派遣：中間報告会...37
　　２－３－１　概要..37
　　２－３－２　中間報告会資料（英語版のみ）..39
　２－４　第 1 次派遣：第２回ワークショップ..43
　　２－４－１　概要..43
　　２－４－２　ワークショップ資料（英語版）..45
　　２－４－３　ワークショップ資料（アルバニア語）..57
　２－５　第 2 次派遣：第１回ワークショップ..69
　　２－５－１　概要..69
　　２－５－２　ワークショップ資料（英語版）..73
　　２－５－３　ワークショップ資料（アルバニア語版）...85
　２－６　第 2 次派遣：第２回ワークショップ..97
　　２－６－１　概要..97
　　２－６－２　ワークショップ資料（英語版）..101
　　２－６－３　ワークショップ資料（アルバニア語版）...115
　２－７第 2 次派遣：第３回ワークショップ..129
　　２－７－１　概要..129
別添資料－３　面談記録..132
　３－１　Kosovo Operator Sistemi, Transmisioni dhe Treu SH.A への電力状況ヒアリング...........132
　　３－１－１　ヒアリング内容...132
　　３－１－２　受領資料..134
　３－２　Ministry of Economics Department of Energy ヒアリング...140
　３－３　炭鉱見学...141
　３－４　コソボ気象水理研究所との打ち合わせ...143
　３－５　Kosovo B Laboratory のイオンクロマトグラフの状況確認...145

３－６　MED、KEK へのヒアリング 147
３－７　MESP へのヒアリング..150
３－８　KHMI ラボへのヒアリング 152
別添資料－４　Standard Operation Procedure (SOP) for Dust content Measurement 154
別添資料—５　分析結果（石炭、飛灰、炉底灰） 178
５－１　工業分析、元素分析...178
５－２　飛灰の定性分析、粒径分布、電気抵抗率 183
５－２－１　飛灰の定性分析...184
５－２－２　飛灰の粒径分布...185
５－２－３　飛灰の電気抵抗率..188
５－３　石炭の X 線回折...194
５－４　飛灰の溶融点等...201
別添資料－６　派遣日程...202
６－１　第 1 次派遣日程（実績） 202
６－２　第 2 次派遣日程（実績） 205
別添資料－７　機器リスト...208
別添資料－８　その他...213
８－１　KEK（Kosovo Energy Corporation）の組織図...213
８－２　Kosovo-A、B TPP での SO_2 発生実態確認調査案 214

別添資料―１　協議議事録

１－１　コンタクトミッション MOU

MINUTES OF UNDERSTANDING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
MINISTRY OF ENVIRONMENT AND SPATIAL PLANNING
OF REPUBLIC OF KOSOVO
FOR
THE CONTACT MISSION FOR
"EXPERT FOR AIR POLLUTION CONTROL JFY 2015"

With respect to the request from the Ministry of Environment and Spatial Planning (hereinafter referred to as "MESP") on the expert dispatch concerning "Expert for Air Pollution Control" (hereinafter referred to as "the Cooperation") proposed in August 2013, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched a contact mission team (hereinafter referred to as "the Team") from April 13, 2015 to April 23, 2015 for the purpose of discussing and clarifying the issues of the Cooperation.

During its stay in the Republic of Kosovo (hereinafter referred to as "Kosovo"), the Team had a series of discussions with the related Kosovo authorities on the activities for the above-mentioned Cooperation.

As a result of the discussions, the Team and the Kosovo authorities confirmed the items described in the attached sheets.

Pristina, April 23, 2015

山田 泰造

Mr. Taizo YAMADA
Senior Advisor / Leader of the Contact Mission Team,
Japan International Cooperation Agency (JICA)

Mr. Arben ÇITAKU
General Secretary,
Ministry of Environmental and Spatial Planning

Mr. Muhamet MALSIU
Director,
Environmental Protection Department,
Ministry of Environmental and Spatial Planning

ATTACHMENT

The Team appreciated very much the Kosovo side's enthusiasm for the JICA Expert Dispatch planned for the Japanese Fiscal Year 2015 execution and extremely well organized preparation by the MESP to discuss detailed aspects of the Experts activities. The following items highlight the major issues discussed during the mission.

1. Outline of JICA Expert Dispatch (JICA Expert activities, dispatch schedule and duration)

The Team discussed with the related Kosovo authorities on the outline of JICA Expert Dispatch including activities, dispatch schedule and duration in the meeting with Mr. Arben Çitaku, General Secretary, Ministry of Environmental and Spatial Planning, Mr. Muhamet Malsiu, Director, Environmental Protection Department, Ms. Nezakete Hakaj, Head of Division, Division for Protection from Industrial Pollution, on April 14 and in the workshops held on April 14 and 15, as shown in the Annexes I and III.

The Kosovo side welcomed the outline contents which would focus on the technical capacity development of the Kosovo side for on-site stack gas measurement based on standard methodologies in order to enhance the National Emission Reduction Plan (hereinafter referred to as "NERP") elaboration and air pollution control in Kosovo .

2. The JICA Expert dispatch framework (objectictive, activities and duration)

The both sides agreed that the frame work for JICA Expert dispatch as shown in the Annex III: The Work Shop for "Expert for Air Pollution Control JFY 2015" Part 1. The highlights are as follows:

(a) Objective:

To develop technical capabilities of Kosovo side in the on-site stack gas measurement for large stationary emission sources such as coal fired power plants to enhance implementation of the Action Plan ("Preparation of National Emission Reduction Plan, 6 November 2014"-- elaborated by the Kosovo participants in JICA training program "Capacity Building towards Air Quality Management".)

(b) JICA Experts Activities:

i) Identify equipment needs for Kosovo side for on-site stack gas measurement and related laboratory works;

ii) Identify technical specification of equipment required for JICA's procurement and for Kosovo side's preparation;

iii) Perform workshops and lectures on on-site stack gas measurement for Kosovo side counterparts;

iv) Perform demonstration measurement at Thermal Power Plants;

v) Perform On-the Job Training for Kosovo side counterpart (on-site sampling, laboratory analysis and data interpretation) by using equipment provided by JICA; and

vi) (Optional if required and viable) Perform on-site stack gas measurements to collect emission data of TPP Kosovo A and B for reporting.

(c) Inputs, duration and dispatch timing:

i) Inputs: 6 man/month experts dispatch consisting of 2-3 emission mesurement specialists and pollution control specialist if applicable, and provision of on-site stack gas measurement related equipment.

ii) Duration: Two times mission of the Experts with 1 – 2 months per mission.

iii) Dispatch timing: The first mission for September- October, 2015 and the second mission for March – April 2016.

The details are subject to change. JICA will update the MESP regarding the operational plan of the Experts if needed.

(d) Other remarks:

i) Review of "The Air Quality Management Strategy" will be performed by JICA Senior Adviser briefly in the later mission.

ii) Assistance for Kosovo side's elaboration of the next phase proposal for JICA assistance will be performed briefly in this mission to enable timely Kosovo side request for the Government of Japan for JFY 2016.

iii) Emission Inventory elaboration and air quality simulation modeling requested by the Kosovo side previously will be examined for the next phase JICA cooperation looking at the priorities in the Kosovo side.

3. Technical Options for on-site stack gas measurement methodology

After series of discussion and site visits, the Team presented the following three options for on-site stack gas measurement methodology to be apllied in technical transfer by JICA Expers. These options are technichally viable given the various constraints

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perceived at the both sides of Kosovo and JICA.

(1) OPTION 1: Dust (JIS Z 8808), SO2 and NOx (Ion Chromatograph Method), O2 and CO2 (Orsat Method), CO(not available)
(2) OPTION 2: Dust (JIS Z 8808), SO2 (Precipitation titration method /Arsenazo Ⅲ method) NOx (Absorptiometric method) , O2 and CO2 (Orsat Method) , CO (not available)
(3) OPTION 3: Dust (JIS Z 8808), SO2, NOx, O2, CO2, CO(Automated analyzer method)

Annex V(Measurement methodology Options) presents detaild description including undertakings by the both sides. The Team recommended the Option 1 which utilizes Ion Chromatograph (hereinafter referred to as "IC") to measure SO2 and NOx owned by MESP laboratory and by Thermal Power Plant (hereinafter referred to as "TPP") Kosovo B.

The Kosovo side strongly requested the Option 3 which utilizes automated analyzer to measure SO2, NOx, O2, CO2 and CO with emphasis on operational efficiency in practice. The Team took a note to consult with the JICA Head Office as the Option 3 requires substantial cost increase. The decision by JICA will be made and notified to the Kosovo side until the end of May. According to the decision on the measurement methodology option, the both side shall start preparation including procurements of equipment, necessary reagents and expendables and the Kosovo side counter- part arrangements among others, as indicated in the Annex V to meet timely the JICA Expert dispatch.

4. Use of Ion Chromatograph (IC)

Further to the discussion on Annex V, the Team confirmed the following ICs can be utilized with additional efforts and provision of supplies by the both sides of Kosovo and JICA:

(a) Ion Chromatograph (IC) owned by MESP laboratory; and
(b) Ion Chromatograph (IC) owned by TPP Kosovo B laboratory.

In case of IC at TPP Kosovo B laboratory, up to one week use will be allowed provided that IC program setting shall be reinstalled for the original use by TPP Kosovo B laboratory after the JICA Experts' use.

5. Required conditions for performing on-site stack gas measurement

On-site stack gas measurements before and after the Electric Static Precipitators (hereinafter referred to "ESPs") are extrempley useful at the TPP Kosovo A and B in order to evaluate ESPs' dust removal efficiencies, boiler combustion conditions and emission data of the Continuos Emission Measurement System (hereinafter referred to "CEMS") . The Team however found that some of sampling ports and their working conditions are less than adequate.

The Team requested the Kosovo side to install flanges at sampling ports and stages, fences and steps around the targeted sampling ports for on-site measurements for safety at TPP Kosovo A and B prior to implementation of the related JICA Experts' activities.

6. Possible modification of JICA Expert activities

The both sides agreed that on-site stack gas measurements data shall be utilized for the improvement of boiler operation and for the effective emission reduction at the TPP Kosovo A and B. In order to enhance the emission data utilization, the Kosovo side strongly requested that the JICA Expert activities shall be expanded to cover related subjects requiring a specialist on thermal power plant combustion control and emission reduction.

7. Questionnaire: Issues to be discussed and clarified during Contact Mission

The questionaires shown in Annex II shall be properly filled up by various participating Kosovo authorities, and be compiled and sumbitted by MESP to JICA by April 24th. In relation with the questionaire, KEK will provide information requested by the Team such as technical information on coal characteristics, ESP and emission data of TPP Kosovo A and B among others. The Kosovo side counter part staff arrangements including MESP and various ahthorities shall be defined and be notified prior to JICA Expert dispatch.

8. Provision of a List of Reagents at MESP laboratory

The Team requested the MESP laboratory to provide an inventory of reagents to be used for IC analysis in the OPTION 1 above noted as the technical Options for on-site stack gas measurement methodology. The MESP laboratory will provide a list of relevant reagents avialable to the Team by April 24th.

9. Provision of storage space for on-site stack gas measurement related equipment

MESP laboratory will provide storage space for on-site stack gas measurement related equipment according to the technical requirements indicated in the Annex II.

10. Provision of autovehicle to transport on-site stack gas measurement related equipment

MESP will provide an autovehicle to transport on-site stack gas measurement related equipment according to the technical requirements indicated in the Annex II.

11. Desirable staff increase in the Kosovo authoriteis for future JICA technical cooperation

The Team suggested that staff increase in the relevant technical areas within the Kosovo authorities, especially at the MESP laboratory will be imperative so that the Kosovo authorities are able to work with any scaled up JICA technical cooperation in fututre.

LIST OF ANNEX

Annex I: Outline of Contact Mission"Expert for Air Pollution Control JFY 2015"

Annex II: Issues to be discussed and clarified during Contact Mission

Annex III: The Work Shop for "Expert for Air Pollution Control JFY 2015" Part 1, Part 2 and 3

Annex IV: Attendee list at Work Shop held on 14 and 15 Apr. 2015

Annex V: Measurement methodology Options

１－２　第 1 次派遣終了時 MOU

MINUITES OF UNDERSTANDING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY MISSION TEAM
AND
MINISTRY OF ENVIRONMENT AND SPATIAL PLANNING
OF REPUBLIC OF KOSOVO
FOR
THE FIRST MISSION FOR
"EXPERT FOR AIR POLLUTION CONTROL JFY 2015"

With respect to the signatory MOU between Japan International Cooperation Agency (hereinafter referred as "JICA"), and the Ministry of Environmental and Spatial Planning (hereinafter referred as "MESP"), the first JICA Expert Mission Team (hereinafter referred as "Experts") visited the Republic of Kosovo (hereinafter referred as "Kosovo") from Oct. 19th 2015 to Nov. 11th 2015.

During its stay in Kosovo, Experts made activities about on-site stack gas measurement for existing Thermal Power Plant (hereinafter referred as "TPP"), enlightenment to achieve ELVS in the Thermal Power Plant and enforcement of the knowledge of related organizations, enforcement of the ability of MESP to grasp conventional conditions in LCP toward developing NERP, and workshops to promote the understandings about this project and enhancement the presence of this project.

Thorough these activities, Experts and MESP confirmed the items described in the attached sheet.

Pristina, Nov.11th 2015

Mr. Masuto SHIMIZU
Leader of the JICA Mission Team
JFE Techno-Research Corporation

Mr. Arben ÇITAKU
General Secretary,
Ministry of Environmental and Spatial Planning

Mr. Muhamet MALSIU
Director,
Environmental Protection Department,
Ministry of Environmental and Spatial Planning

ATTACHMENT

Experts appreciated very much the Kosovo side's enthusiasm for Experts to execute all scheduled activities planned in this 1st mission, and Experts extremely appreciated the assistance to our activities.

The following items are the activities, outcomes, points at issue, and comments to the intended purposes in this mission.

1. What Experts do in this 1st visit

① Experts transfer the on-site stack gas measurement technology, which helps C/P to improve understanding of the on-site stack gas measurement and to get better measurement technology

a. Items implemented

- Experts did the dust measurement of both inlet and outlet of ESP (Kosovo A-5, A-3 TPP).
- Experts did the dust measurement of both inlet and outlet of ESP (Kosovo B-1 TPP).
- Experts demonstrated the method of dust measurement through the measurements in Kosovo A & B TPP.
- Experts had a meeting about how to manage Ion Chromatograph with KHMI.

b. Outcome and Points at issue

- Experts showed the dust content for the measured plants to C/P. However it becomes clear that these values are far over the EU regulations,
- The measurement results of Kosovo A TPP did not have consistency with the exhaust gas volume calculated from boiler operation data. The measurement points required more precise and strict measurements because of its position and location. This required further measurement and repetition of measurement which will lead to more precise data.
- The measurement results of Kosovo B TPP indicate that the 2 ESPs for B-1 TPP have the big exhaust gas volume difference.
- Measurement of SOx、NOx are detected with the simple method of using detection tube. NOx indicated the values of 400～600ppm. These values are also over EU regulations. On the other hands, SOx indicates only the value of 0～100ppm. Because the coal consumed in both TPP has pretty high percentage of Calcium (Ca),there is a possibility of in-furnace desulfurization proceeds. The sample brought into Japan may clarify this possibility by analysis. And the measurements in the 2nd mission will give us more clear results.
- Through the meeting about Ion Chromatograph, the operation of this instrument requires more instruments and setting up by producer. Bringing back this issue to Japan, experts have discussions with JICA and SHIMADZU (producer), and have to decide how to handle this issue in the 2nd mission. Experts guess that the operation of Ion Chromatograph is hard to be conducted. It will require more costs and manpower.

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The example of instruments required: especially deionized water unit and super deionized water unit etc.

c. Comment

- For C/P to master the dust measurement seems to be far away to reach the final goal. It requires at least 3 full-time persons to learn and take part in all our activities of dust measurements during our stay in Kosovo.

  The proper measurements require the preparation, transportation, installment, securement of safety before measurements, then measurements, and clearing of the measurement space, transportation, and cleanliness of measurements equipment. To be able to make and to know measurement is not the main element of this work.

  Only people who can do these activities can make a good measurement.

- About Ion Chromatograph experts will contact C/P what experts do in the 2nd mission after consulting JICA and SHIMADZU.

② Experts enlighten how to utilize the flue gas data in order to achieve ELVS in the Thermal Power Plant, and enforce the knowledge of related organizations (MESP, KHIM, Kosovo Energy Corporation (hereinafter referred to as "KEK"), Kosovo A Thermal Power plant (hereinafter referred to as "TPP"), and Kosovo B TTP.

a. Items implemented

- Experts showed the measurements results and let the C/P people to recognize that some of these values to surpass the EU regulations.

b. Outcome and Points at issue

- Experts showed the demonstration about how to make the proper measurement of dust.

c. Comment

- C/P people are the beginners to the measurement and its values. They have to learn from now on that important matters are to understand what meaning these values are, and to arrange the present problems, and to discuss how to tackle with these problems in the future.
- The measurement results contribute not only to the evaluation of the emission, but also to help the improvements of boiler operation. Utilization of these results must be very helpful to the operation of boiler. From this point of view, experts recommend for C/P to bring up proper human resources to study, understand and tackle with environmental problem.

③ Through activities of the on-site stack gas measurement and utilization of these data, Experts enforce the ability of MESP to grasp conventional conditions in LCP toward formulating emission inventory, and study and implement the counter measures to achieve ELVs in LCP. (Toward developing NERP)

a. Items implemented

- ➢ Experts made the interview to TPPs in order to grasp the conventional boiler operations and collected relevant data which are expected to be required for application to NERP.

b. Outcome and Points at issue

- ➢ The measured values of dust content and NOx surpassed the EU regulations. This is the points of how to handle these issues in the future.
- ➢ Experts recommended which and what kinds of values are required for application to NERP.
- ➢ MESP requests experts to support for MESP to file the application to NERP when MESP requested.

c. Comment

- ➢ SO2 has the possibility to clear the EU regulations as it is. (requires the confirmation of 2^{nd} mission measurement result.)
- ➢ Dust content and NOx have severe conditions to secure the EU regulations. Experts support how to tackle with these measures.

④ Experts hold workshops to promote the understandings of related organizations about this project, and enhance the presence of this project.

a. Items implemented

- ➢ Experts held work shop 2 times. 1^{st} work shop presents the environmental problems in Japan, and 2^{nd} mission is scheduled to present general description of boilers including combustion calculations etc.
- ➢ After finishing Kosovo A TPP, experts explain about the measurement result of Kosovo A TPP as an interim report, and dust measurement method again.

b. Outcome and Points at issue

- ➢ In the 1^{st} work shop C/P people showed their interest to the presentation.
- ➢ In the interim report, after the measurement data were shown, big argument started inside C/P about the results.

2. About the 2nd mission

① Experts transfers the on-site stack gas measurement technology, which helps C/P to improve understanding of the on-site stack gas measurement and to get better measurement technology

a. Items implemented

- Experts make the measurement of Kosovo B2 TPP for the inlet and outlet of ESP.

  *) Please prepare to make measurements holes at the inlet side of two ESPs of Kosovo B2 TPP by the 2nd mission.

  *) Experts send the English version of SOP (standard operation procedure) to Ms. Letafete Latifi from Japan beforehand. Experts expects for C/P to translate them and prepare for 1st dust measurement at Kosovo B2 TPP. The schedule keeps the 3 days measurements of the 1st week in March, and on the 1st day of the measurement, C/P measure the dust only by themselves (Experts just look the measurement and do nothing about dust measurement). Experts evaluate C/P ability and capacity from this measurement.

- Experts make the dust measurement of Kosovo A (Kosovo A-5 is preferable) again for the inlet and outlet of ESP.

  *) In the 1st mission the scattering of the data was big, and because of that try to measure it again.

- To all the Kosovo A & B TPP under operation, Experts do the measurement of Exhasut gas (CO、CO2、O2、NOx、SO2) with using automated gas analyzer.
- The handling of Ion Chromatograph follows the result decided in Japan.

b. Points at issue

- The most important point is how much C/P can learn how to measure dust content and automated gas analyzer. There exists no technology advancement without doing by C/P people themselves.

c. Comment

- Doing the dust measurement by C/P people themselves will promote the technology of how to measure the dust content.
- Experts try to teach the meaning of the measurement with automated gas analyzer.

② Experts enlighten how to utilize the flue gas data in order to achieve ELVS in the Thermal Power Plant, and enforce the knowledge of related organizations (MESP, KHIM, Kosovo Energy Corporation (hereinafter referred to as "KEK"), Kosovo A Thermal Power plant (hereinafter referred to as "TPP"), and Kosovo B TTP.

a. Items implemented

- Experts show all the measurement results including 1st mission, and let C/P people to recognize these results.

b. Points at issue

- To learn for C/P people how to understand the results.

- ➢ To arrange how to evaluate and utilize these results
- ➢ To recognize the necessity of emission measurements for future activities

c. Comment

- ➢ Only the result becomes the issue to be discussed. Emission results should be properly utilized, and To grasp the relation between the emission data and operation is the most important point to be discussed.

③ Through activities of the on-site stack gas measurement and utilization of these data, Experts enforce the ability of MESP to grasp conventional conditions in LCP toward formulating emission inventory, and study and implement the counter measures to achieve ELVs in LCP. (Toward NERP)

a. Items implemented

- ➢ Experts continuously keep supporting to collect data relating to NERP. And Experts propose the probable method of improving boiler operation about emissions.

b. Points at issue

- ➢ Although experts propose and support to improve boiler operation (for example, reduction of O2 in exhaust gas), the improvement must depend on the judgment and determination of C/P people.

④ Experts hold workshops to promote the understandings of related organizations about this project, and enhance the presence of this project.

a. Items implemented

- ➢ Interim report of measurements results and how to use automated gas analyzer
- ➢ Future measures of boiler operation improvement based on the measurement results

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QEVERIA E KOSOVËS - VLADA KOSOVA - GOVERNMENT OF KOSOVO
MINISTRIA E MJEDISIT DHE PLANIFIKIMIT HAPËSINOR
MINISTARSTVO SREDINE I PROSTORNOG PLANIRANJA
MINISTRY OF ENVIRONMENT AND SPATIAL PLANNING
Njësia Org. / Org. Jedinice / Org. Unit: 30 | Nr. Prot: / Broj Prot: / Prot. No.: 1526/16
Nr i faqeve / Br. Stranica: / | Data: / Datum: / Date: 31/03/2016
Prishtinë / a

MINUTES OF UNDERSTANDING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY EXPERT TEAM
AND
MINISTRY OF ENVIRONMENT AND SPATIAL PLANNING
OF REPUBLIC OF KOSOVO
FOR
"EXPERT FOR AIR POLLUTION CONTROL JFY 2015"

With respect to the signing of MOU in 2015 between Japan International Cooperation Agency (hereinafter referred as "JICA"), and the Ministry of Environmental and Spatial Planning (hereinafter referred as "MESP"), the JICA Expert Team (hereinafter referred as "JET") visited the Republic of Kosovo (hereinafter referred as "Kosovo") from Oct. 19th 2015 to Nov. 11th 2015 and Mar. 7th 2016 to Mar. 31st 2016..

During its stay in Kosovo, Experts carried out activities about on-site stack gas measurement for existing Thermal Power Plant (hereinafter referred as "TPP"), enlightenment to achieve ELVs in the Thermal Power Plant and strengthening of the knowledge of related organizations, strengthening of the ability of MESP to grasp existing conditions in LCP toward developing NERP, and workshops.

JICA Head Office mission (Mr. Taizo Yamada) joined the workshop discussion on March 29th.

Thorough these activities, Experts and MESP confirmed the items described in the attached sheet.

Pristina, March 30th 2016

Mr. Masuto SHIMIZU Leader of the JICA ExpertTeam JFE Techno-Research Corporation	Mr. Arben ÇITAKU General Secretary, Ministry of Environment and Spatial Planning
山田 泰造 Witnessed by Mr. Taizo Yamada JICA Head Office Mission Senior Adviser (Environmental Management) Japan International Cooperation Agency (JICA)	Mr. Muhamet MALSIU Director, Environmental Protection Department, Ministry of Environment and Spatial Planning

ATTACHMENT

JET appreciated very much the Kosovo Side's enthusiasm for JET to execute all scheduled activities planned in both 1st and 2nd mission, and JET extremely appreciated the assistance to their activities.

The results and issues based on this mission activities and the future direction are discussed as follows.

1. Results and issues derived from this mission
   a. MESP and related authorities and organizations (hereinafter referred as "Kosovo Side"). and JET confirmed that Dust concentrations in exhaust gas from the boilers of both Kosovo A TPP and Kosovo B TPP by far exceed the Emission Limit Values (hereinafter referred as "ELVs") defined in Directive 2010/75/EC of the European Parliament and of the council (hereinafter referred as "EC Directive").
      - Both Kosovo Side and JET confirmed that these dust concentration values also by far exceed the specification of Electrostatic Precipitator (hereinafter referred as "ESP").
      - In addition, JET let MESP understand that the dust meter installed in the boilers does not show a reliable value (calibration has not been accomplished).
   b. JET conducted the measurement of SO_2 and NO_X by using the automated gas analyzer for both Kosovo A TPP and Kosovo B TPP. Both Kosovo Side and JET confirmed the following:
      - NO_X showed a stable value of 700 ~ 800 mg/Nm^3 (reference O_2=6%).
      - SO_2 showed a fluctuation from 0 to 1,000 mg/Nm^3 (reference O_2=6%).
   c. Both Kosovo Side and JET confirmed that the Continuous Emission Monitoring System (hereinafter referred as "CEMS") installed in Kosovo B TPP has a problem with the location problem for maintenance as well as calibration.
      - CEMS is installed at the position of 90m of the stack where the access is very hard for the maintenance man.
      - Calibration of CEMS must be conducted at the position close to CEMS according to EC Directive. In particular, the dust meter must be calibrated by the isokinetic dust measurement method. It is hard and dangerous to handle instruments in this location.

      Furthermore, the point where JET conducted measurement in this mission in Kosovo A TPP and Kosovo B TPP were not appropriate, because the measurement results were not uniform, as this was not a representative measurement point.

      Because of the above-mentioned situation, both Kosovo Side and JET agreed to install new measurement points for both Kosovo A TPP and Kosovo B TPP which are envisaged to be a representative point.
   d. Both Kosovo Side and JET agreed that the technology transfer of on-site stack gas measurement was not sufficient. The acquisition of emission data was set as a priority in the mission, upon the request from MESP for NERP elaboration. Kosovo Side requested more training about technology transfer of on-site stack gas measurement.
   e. MESP (Kosovo Environmental Protection Agency/Kosovo Hydro-meteorological Institute) expects

to use Ion Chromatograph method as a reference method of on-site stack gas measurement for SOx and NOx. However, Ion Chromatograph requires adjustment and operational instructions.
Furthermore EC directive demands measurement of mercury in the exhaust gas which requires sampling and analysis technology.

2. Future direction based on these results and issues
The underlined parts in the following articles are strongly requested by the Kosovo Side to be addressed urgently, in order to sustain the Kosovo Side's efforts initiated by the JET activities.

a. Kosovo Side and JET agree that present measurement points are not appropriate, and there is a need to install other measurement points for future on-site stack gas measurement. These measurement points must be confirmed as representative by conducting on-site stack gas measurement.
It is important to specify the representative measurement points, not only for monitoring and reporting of emission data to Energy Community, but also for studying in order to find out the mechanism related to the fluctuation of dust and SO_2 concentration in exhaust gas. The most appropriate dust and SO_2 reduction measures can be designed based on such a study.
It is strongly recommended to find a representative measurement point and prepare for its measurement arrangement before starting next step to study behavior of dust and SO_2.
b. CEMS is required to be installed at an appropriate position in order to monitor and report emissions to Energy Community. Kosovo B TPP has a CEMS which monitors dust, SO_2 and NO_X, but the location of measurement point is problematic for operation and maintenance of the equipment. It is necessary to secure an appropriate place for operation (measurement)
c. Present ESP does not show the projected capacity, as it is affected by many factors (exhaust gas temperature, exhaust gas volume, heterogeneity of gas flow, etc.). In order to confirm the present condition of ESP, it is required to analyze lignite and fly ash and to study boiler operation at the same time, which will lead to the study of the cause of low dust collection efficiency. This study contributes to the evaluation of proper and effective measures to achieve ELVs, and furthermore it will become the base data for deciding on specification of ESP reinforcement.
d. Reduction of SO_2, NO_X is as follows;
   - NO_X shows a stable value of 700 ~ 800 mg/Nm^3 (reference O_2=6%). It is indispensable to evaluate the introduction of low NO_X burner.
   - The fact that SO_2 sometimes shows the value of 0 mg/Nm^3 suggests that the in-furnace desulfurization occurs in the boiler. Utilization of this phenomenon can provide an effective measure for reduction of SO_2. The study of factors of influence to this phenomenon (percentage of CaO, combustion temperature, O_2 concentration in combustion area, etc.) can enable to evaluate effective and economic improvement or reinforcement for desulfurization.
   - The study of the relation among SO_2 fluctuation, the property of Lignite, fly ash and boiler operation is very important to design measures for desulfurization.
   - It is immediately required to collect data of chronological changes (at least one month for both

Kosovo A and Kosovo B) of how SO_2 is fluctuating. This enables the analysis of the mechanism of this SO_2 phenomena in the future, leading to the design of the most optimized desulphurization process.

e. At the workshops, JET introduced not only the probable dust, SO_2, NO_X reduction methods but also the necessary attention while applying these methods. In case of introduction of emission control technology to the boilers, it is important not only to know the present emission values but also to understand Lignite quality and features of the boiler in order to design appropriate measures and specifications.

f. MESP has not yet conducted on-site stack gas measurement by themselves. More instructions and experience is required to master this technology. MESP has set a priority for KHMI and Environmental Inspectorate to master this technology, but also Kosovo Energy Corporation (hereinafter referred as "KEK") is interested to take part in this process.

g. KHMI is in possession of the Ion Chromatograph, however they do not have the necessary experience to utilize it. KHMI needs to use the Ion Chromatograph as a reference method for on-site stack gas measurement and JICA support is necessary at this point. The use of the Ion Chromatograph method requires the following:
   - Ion Chromatograph method requires training of sampling and instructions for operation
   - In order to operate the Ion Chromatograph, one week is required for the set-up and adjustment of its instruments
   - Training for operation requires two weeks.

h. Measurement of the mercury in the exhaust gas requires sampling and analysis technology.
   - KHMI has instruments and the experience for analyzing mercury
   - KHMI can provide reagents but needs a sampling technology and its instruments.

i. KHMI request to analyze components in the dust by using Ion Chromatograph. However, JET has explained that priority in analysis by Ion Chromatograph shall be placed on the issues related to the EC Directive limited only to NO_X, and SO_2 measurement.

j. In addition to air pollution control issues, KEK requests environmental management of the Power Plants as a whole. The JICA Head Office Mission responded that the air pollution control aspects are included in the MESP request already for JICA's consideration, but other environmental management aspects of TPPs shall be a separate request in future for which JICA's interest is unknown.

k. MESP strongly requests continuity of JICA Experts for future JICA assistance, because JET in this mission is familiar with not only conditions and the situation in Kosovo A TPP, and Kosovo B TPP, as well as the technical ability of each counterpart for both preparation and issues in next project.

l. JICA Head Office Mission will convey the Kosovo Side's requests above discussed to examine any possible supports in the requested technical cooperation project in 2015 - Capacity Development Project for Pollution Control for Major Emission Sources and relevant preparatory activities in 2016.

- End -

別添資料－２　報告会（ワークショップを含む）

２－１　第 1 次派遣：ワークプラン概要説明会

２－１－１　概要

会議名	ワークプランに関する説明会			
実施場所	MESP（環境空間計画省）			
日　時	2015 年 10 月 19 日（月）13：00~15：30		場　所	環境空間計画省（MESP）
出 席 者	先方	C/P 関係者一同		
	調査団側	清水、臼井、中嶋		
配布資料	151019 Meeting Agenda、Outline of Work Plan、Work plan			
収集資料	なし			
筆記者	清水			

（目的）

関係者に対し、本プロジェクトの活動内容及び第 1 次派遣、第 2 次派遣時の活動内容とそのスケジュールの概要を説明し、関係者の合意を得た。

（結果）

1. 調査団の自己紹介を実施した。
2. Kosovo 側関係者の自己紹介を受けた。
3. 今後の作業を円滑に進めるために C/P の顔写真入りの List を作成することとした。
4. “Outline of Work Plan”に沿って、本プロジェクトの活動内容及びスケジュールについて説明を実施した。
5. 今週の活動内容について関係者との打ち合わせを実施し、調整を実施した。
6. 現場での排ガス測定詳細に関しては、明日の現地調査結果を踏まえて協議する事とした。

- 以上 -

２－２－２　ワークプラン説明会資料

Republic of Kosovo
Expert for Air Pollution Control
- Outline of Work Plan -

JICA Mission Team
19th, Oct, 2015
at Ministry of Environment and Spatial Planning

独立行政法人 国際協力機構

Introduction of JICA Mission Team (1/2)

Name		Title of the field	Assignment
Masuto SHIMIZU		Project Manager, On-site stack gas measurement	- Planning and controlling of the project - Support On-site stack gas measurement - Workshop for Measurement of Dust, SOx and NOx, - etc.
Tadayoshi Usui		On-site stack gas measurement	- On-site stack gas measurement - Measurements, Instruction and supporting measurement by C/P persons - Arrangement of the measured data - etc.
Yasufumi NAKAJIMA		Supervising for LCP emissions Utilization of emission data	- Study on conventional TPP operation and study on their problems - Workshop for Boilers - Support the proposal for developing NERP - etc.

1

Introduction of JICA Mission Team (2/2)

Name	Position	Career
Masuto SHIMIZU	JFE Techno-Research Corporation Business Consulting Division Principal Manager	- Engineering of Energy Department in the integrated steel works - Management of Waste Treatment Plant - Energy Saving Diagnosis for the Steel Plants in south-east Asia
Tadayoshi Usui	JFE Techno-Research Corporation Instrument Technology Division Leader	- Environmental Measurement Section (Exhaust gas, etc.) - JICA mission Capacity Development Project for Air Pollution Control in Ulaanbaatar City
Yasufumi NAKAJIMA	Thermal Power Engineering Institute Director	- Engineering of Power Plant - Design of Boiler for Power Plant - JICA mission Capacity Development Project for Air Pollution Control in Ulaanbaatar City

2

Purposes of JICA Mission Team

4 major purposes for 2 missions
(The 2nd mission will be in March 2016)

1. Implement and Transfer On-site stack gas measurement technology
2. Enlighten the utilization of exhaust gas data and Enforce its knowledge
3. Enforce the ability to grasp conventional conditions in LCP toward formulating emission inventory, and Study and Implement the countermeasures to achieve ELVs.
4. Deepen the understandings of this project through Work Shops.

3

独立行政法人 国際協力機構

Purposes of JICA Mission -1a

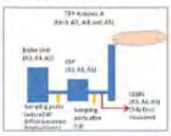
1. Implement and Transfer On-site stack gas measurement technology

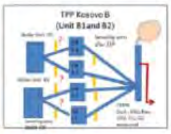
Measurement: Detailed schedule is in the Work Plan

Facility	Dust	SOx, NOx
Kosovo A3 TPP	● (red)	● (blue)
Kosovo A4 TPP	● (red)	● (blue)
Kosovo A5 TPP	● (red)	● (blue)
Kosovo B1 TPP	● (red)	● (blue)
Kosovo B2 TPP	● (blue)	● (blue)

● The 1st mission
(SOx and NOx measured by simple method (inspection tube))

● The 2nd mission
SOx and NOx are measured by automatic gas analyzer





4

独立行政法人 国際協力機構

Purposes of JICA Mission -1b

1. Implement and Transfer On-site stack gas measurement technology

The 1st mission
- Demonstrate and Measure Dust: Inlet and Outlet of ESP
  Mainly conducted by the mission members
  for 4 plants (10 locations)
- Check and Examine the Ion Chromatograph (KHIM laboratory)

The 2nd mission
- Measure Dust: Inlet and Outlet of ESP for Kosovo B2 TPP
  Conducted by the C/P members
- Measure SOx and NOx
  Conducted by the C/P members with automatic gas analyzer
  For all plants (7 locations) at Outlet of ESP
- Demonstrate the Ion Chromatograph (KHIM laboratory)
  (If it becomes available)

5

Purposes of JICA Mission -2

2. Enlighten and the utilization of exhaust gas data and Enforce its knowledge

The 1st mission
- Collect the information: the specification of the TPP facilities, the current operating condition, etc.
- Record the operating condition during the measurement
- Sample coal, bottom ash, fly ash for analysis

The 2nd mission
- Record the operating condition during the measurement
- Examine the current problems of each TPP
- Propose improvement of the boiler and environmental effects

Purposes of JICA Mission -3

3. Enforcement the ability to grasp conventional conditions in LCP toward formulating emission inventory, and Study and Implement the countermeasures to achieve ELVs.

The 1st mission
- Obtain the basic information about air pollutions like policies, strategies, etc.
- Grasp the current conditions of TPP
- Advise "Action plan" in "Air quality management Strategy"

The 2nd mission
- Provide information of TPP for establishing emission inventory
- Extract problems to achieve ELVs for TPP and for developing NERP
- Propose measures to achieve ELVs for TPP, and arrange problems for developing NERP

Purposes of JICA Mission -4

4. Deepen the understandings of this project through Work Shops.

The 1st mission
- Exhaust Gas Measurement and Analysis in Japan
  - Dust Measurement -
- Air Pollution and Boiler

The 2nd mission
- Exhaust Gas Measurement and Analysis in Japan
  - SOx and NOx Measurement –
- Summary of On-Site Stack Gas Measurement Results
- Emission control Technology of Boiler, and effective countermeasures, and Introduction of Capacity Development for Air pollution control in other country

Mission Team Location of Work (The first mission)

Date / Place	19	20	21	22	23	24	25	26	27	28	29	30	31	1
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
MESP														
Kosovo A														
Kosovo B														
Date / Place	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
MESP														
Kosovo A														
Kosovo B														

Thank you for your cooperation

２－２　第１次派遣：第１回ワークショップ

２－２－１　概要

<table>
<tr><td>会議名</td><td colspan="4">ワークショップ（ダスト測定）</td></tr>
<tr><td>実施場所</td><td colspan="4">MESP（環境空間計画省）</td></tr>
<tr><td>日　時</td><td colspan="2">2015 年 10 月 21 日（水）13：00~15：00</td><td>場　所</td><td>MESP 会議室（17F）</td></tr>
<tr><td rowspan="2">出 席 者</td><td>先方</td><td colspan="3">Ms. Hakaj Nezakete、Mr. Abdlillah Pirce、Ms. Letafete Latifi、Mr. Mentor Shala、Mr. Shkumbin Shala、Ms.Anbenerha ysuy、Mr. Xhemajl Sejdiu、Mr. Lulzim Korenica、Ms.Qefsere Muraky、Ms.Visare Hoxna Istefi、Mr.Agim Morina、Mr. Sabri Simnica(#A)、Mr. Xhemajl Sejdiu、Mr. Milaim Kelmendi(#B)、</td></tr>
<tr><td>調査団側</td><td colspan="3">清水、臼井、中嶋、（通訳：Mr. Nehat、Mr. Kastriot）</td></tr>
<tr><td>配布資料</td><td colspan="4">Exhaust Gas Measurement and Analysis in Japan (On the air environment)</td></tr>
<tr><td>収集資料</td><td colspan="4">アンケート</td></tr>
<tr><td>筆記者</td><td colspan="4">清水</td></tr>
</table>

（目的）

1. 第１次ミッションで予定している２回のワークショップのうち、第１回目を実施した。内容として日本における公害の歴史と公害４大病および公害に対応する法律の歴史と、成第１次派遣に実施するダスト測定の考え方とその実施方法・ダスト濃度の算出方法について説明を実施した。
2. ワークショップの最後に、Kosovo A TPP、B TTP での石炭、飛灰、主灰のサンプル採取をお願いし、了解を得た。

（結果）

1. 質問

① バグフィルターでダイオキシンを取るとの説明があったが、本当か？
日本のほとんどの廃棄物焼却炉はダスト補修にバグフィルターを採用しており、このバグフィルターで同時にダイオキシンも除去することができる。

② ダイオキシンを含んだ飛灰は埋め立てするのか？
灰はその後溶融されることが多いが、いずれにしろ再度飛灰が発生し、この飛灰は埋め立てされる。

③ 主灰と飛灰をサンプリングするということだが、両方サンプルする理由は何か？
主灰と飛灰は発生メカニズムが違うため、成分等が異なることが普通である。

Expert for Air Pollution Control
The Work Shop for

Exhaust Gas Measurement and Analysis in Japan
(On the air environment)

JICA Mission Team
21st October, 2015
at Ministry of Environment and Spatial Planning

- Orientation-

Introduction
- History of environmental pollution in Japan
- Progress of environmental related legislations
- Generation mechanisms of soot and dust, SOx, and NOx
- Removal methods of soot and dust, SOx, and NOx

On-site Stack Gas Measurements

- **Dust measurement** -

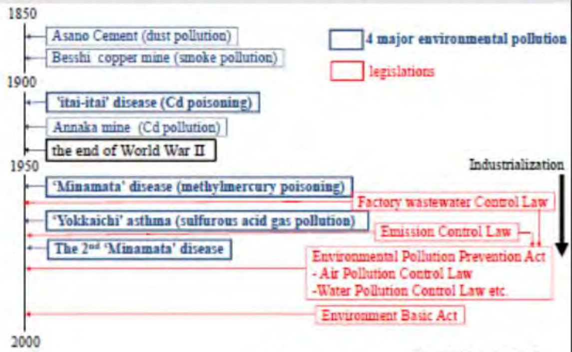
in the Japanese Industrial Standards (the JIS method) and analysis techniques
- On-site stack gas measurement in the Air Pollution Control Act (Dust)

Attention on on-site stack gas measurement

Introduction

- History of environmental pollution in Japan
- Progress of environmental related legislations
- Generation mechanisms of soot and dust, SOx, and NOx
- Removal methods of soot and dust, SOx, and NOx

History of environmental pollution in Japan



4 Major pollutions in Japan

- caused by environmental pollution -

1. "Itai-itai disease" Cd poisoning

From 1910 to the early 1970s,
Cadmium from the zinc refining factory flowed into a local river.
People take in Cd through water, farming products, etc.

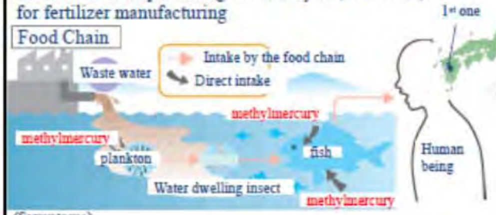
(Symptoms)
Kidney damage and Osteomalacia (softening bones)
Bones starts to soften and break at various locations of the body.
And patients cry "Itai, itai (ouch-ouch)",
therefore it was named "Itai-itai disease".

4 Major pollutions in Japan

- caused by environmental pollution -

2. 3. "Minamata disease" (methylmercury poisoning)
In 1956, the 1st one and in 1965, the 2nd one occurred
Both come from producing acetaldehyde (CH_3CHO) for fertilizer manufacturing

Food Chain



(Symptoms)
Methyl mercury ingested into the body disables the brain and nervous system.
→Feeling of limbs gets numb. Those who were severely disabled were seized with cramps and some of them died.

4 Major pollutions in Japan

- caused by environmental pollution -

4. "Yokkaichi asthma" **(sulfurous acid gas pollution)**
From 1961, this asthma started.
Petrochemical complex, etc. using petroleum emitted a great amount of sulfurous acid gas to the air

Yokkaichi in 1960's

Present Yokkaichi

(Symptoms)
When sulfur oxides are inhaled, it causes mucosal membrane irritation in the respiratory tract. When the amount of exposure to sulfur oxide it induces respiratory diseases such as bronchial asthma.

Other Environmental Issue

- Air pollution in China -

Air pollution in China becomes a big social problem in China, mainly caused by exhaust gas from vehicles, and **PM2.5 and PM10** from power generation and district heating plants with using coal.

In China, from the report of WHO in 2014, it is said that 38% of the people in China live in the unhealthy area of an inappropriate atmosphere level.
Many people may die of disease of heart and the lungs, apoplexy (stroke), etc. caused by the air pollution.

Other Environmental Issue

- Photochemical smog caused by mainly NOx, O_3, etc. - (Smog = smoke + fog)

The fine particles of the photochemical oxidant of the gas ingredient consisting of ozone or aldehyde (R-CHO), and the solid ingredient consisting of nitric or sulfate mix

(Symptoms)
The photochemical oxidant causes a stimulation to eyes and a throat, and skin by the ingredients of the photochemical oxidants.

Progress of environmental related legislations

Year	Name of the law	Remarks
1958	Factory wastewater Control Law	
1962	Emission Control Law	
1967	Environmental Pollution Prevention Act	Corresponds to environmental problems
1968	Air Pollution Control Law	Corresponds to air pollution problems
1970	Water Pollution Control Law	Corresponds to water pollution problems
1971 ~	Individual laws	offensive odor, noise, vibration, etc
1993	Environment Basic Act	In order to cope with broader problems including global environme

Environment standards for air

- Air Pollution Control Law -

Substance	Standard value
SO_2 (Sulfur dioxide)	<=0.04 ppm: average daily value <=0.1 ppm: average hourly value
CO (Carbon monoxide)	<=10 ppm: average daily value <=20 ppm: average hourly value
Suspended particulate matter (SPM)	<=0.1 mg/m³: Average daily value <=0.2 mg/m³: average hourly value
Nitrogen dioxide (NO_2)	0.04 ppm to 0.06 ppm: average daily value
Photochemical Oxidants	<=0.06 ppm: average hourly

Standards have been established for other substances, including benzene, trichloroethylene, tetrachloroethylene, dichloromethane, dioxins, and fine particulates matter.

Emission standards (air)

- Air Pollution Control Law –

Values are different depending on the scale, and type of facilities.
For example:

Type of facility (32 type)	Scale (Exhaust gas volume)	Controlled value of soot and dust	Controlled value of NOx
Coal Boiler	>=200,000 m³	0.1g/m³	200 to 250ppm
	200,000m³>= >=40,000	0.2g/m³	250 to 320ppm
	40,000 m³>=	0.3g/m³	250 to 350ppm
Waste incinerator	>=4ton/h	0.04g/m³	250 to 700ppm
	4ton/h>= >=2ton/h	0.08g/m³	
	2ton/h>=	0.15g/m³	

Soot and dust, SOx and NOx

Generation mechanism

Substance	Generation mechanism
Soot and dust	- Fly Ash is generated through combustion - Substances (metallic materials, etc.) are gasified and solidifies during the cooling period of the exhaust gas. - Soot is generated by incomplete combustion of volatile hydrocarbons.
SOx (sulfur oxides)	is generated by the oxidation of sulfur in the fuel. SOx $=SO_2 + SO_3$: It is said SO_3 in SOx is 2~3 %.
NOx (nitrogen oxides)	Fuel NOx + Thermal NOx -Fuel NOx: the combustion of nitrogen in the fuel -Thermal NOx: the reaction with nitrogen in combustion air (generated at high temperature portion of the flame)

Soot and dust, SOx and NOx

Removal methods and its mechanism

Substance	Removal method	Mechanism of removal
Soot and dust	Bag filter dust collector	Filters with exhaust gas with a fiber cloth
	Electrostatic precipitator	Collects soot particles in the exhaust gas around the collecting electrode by charging with a high voltage.
SOx (sulfur oxides)	Addition of neutralization agent	Adding alkali (calcium hydroxide) removes SOx as calcium sulfite (gypsum). $SO_{2\sim3}$+$Ca(OH)_2$→$CaSO_4$+H_2O
NOx (nitrogen oxides)	NOx removal by catalyst	NOx is removed by the chemical reaction between ammonia and nitrogen oxides at around 300°C with a catalyst. $4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$

On-site Stack Gas Measurements

- **Dust measurement** -

In the Japanese Industrial Standards (the JIS method: JIS Z 8808) and analysis techniques

・On-site stack gas measurement in the Air Pollution Control Act (Dust)

On-site Stack Gas Measurements

- The purpose of the measurement -

1. The legal measurement, voluntary measurement
- Checking the observance of the regulation limits
- Reporting the emission value to the organization
- Publication of emission data to the community

2. Plant management
- Evaluation on emission condition and analyzing of operation condition of the plant.
- Judgment of the operating condition of emission control facilities
- Judgment of the mechanical condition of emission control facilities

⇒ Study on operation improvement, maintenance, revamping, etc. of the plant

On-site Stack Gas Measurements

Summary of the measurement・ analysis method

①Gas sampling method
- Filtration sampling method・・・・Dust, Metl, etc
- Direct sampling method・・・・・ Inert gas (O2、CO2 etc)
- Liquid sampling method・・・・・ HCl, SOx, NOx, etc

②Solid, liquid method
- Direct sampling method ・・・・・Random sampling、Stratification sampling Reduction Distribution etc.

③ Analysis method
- The weight method・・・・・・・ Exhaust gas in dust, moisture etc.
- Absorption Photometry (AAS) ・ NH3, HCN, Cr^{+6}, NOx, SO, etc.
- Atomic Absorption Spectrophotometry (AA) ・・Pb, Cd, Hg, Cr, As, Se, Mn, Cu, Fe, etc

High frequency plasma emission spectrometry analysis/ (Mass spectrometer) ICP/MS
- Ion chromatograph (IC)・Anion (F, NO_3, SO_4, etc.) Cation (Na, K, NH_3 etc.)
- Gas chromatograph/ (Mass spectrometer) GC/(MS) ・・・・・・Inorganic gas, Non-degradable organic gas, PCB, dioxins
- High performance liquid chromatograph (HPLC) ・・・・・ Degradable organic matter (water-soluble)
- Liquid chromatograph/ (Mass spectrometer) LC/MS ・・・・・ High polymer degradable organic matter (water-soluble)

On-site Stack Gas Measurements

Analyzer measuring equipment

Ion chromatograph(IC)

Absorption Photometry (AAS)

Orsat analyzer

CO,CO2,O2,NOx,SO2 automated analyzer

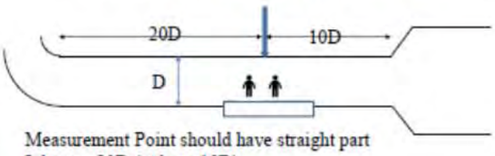
From next page

Starts the Lectures of the dust measurement

On-site Stack Gas Measurements
- Dust measurement -

- Lectures of the dust measurement -
- Determination of the measurement point -

Measurement Point should have uniform flow



Measurement Point should have straight part
Inlet >= 20D (at least 10D)
Outlet>= 10D (at least 5D)
(This length is same as the standard for installing flow meter)

独立行政法人 国際協力機構

On-site Stack Gas Measurements
- Dust measurement -

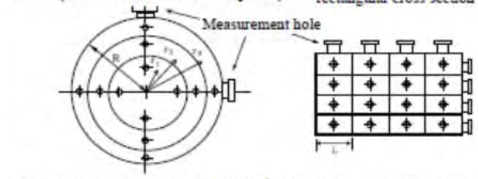
- Determination of the measurement point -

Measurement points msut be chosen depending on the size and shape of the cross section of the duct.

The measurement points are the center of the same cross sectional area.

Measurement points for circular cross section (in case of 12 measurement points)

Measurement points for rectangular cross section



When the duct is small in size (0.25 m^2 or less in cross section), the center point may be designated as a measurement point.

独立行政法人 国際協力機構

On-site Stack Gas Measurements
- Dust measurement -

- Determination of the measurement point -

The following tables show the measuring points for big duct.

Measurement points for circular cross section

Applicable duct diameter 2R (m)	Number of radial sections	Number of measurement points	Distance from the duct center at the measurement point (m)				
			r_1	r_2	r_3	r_4	r_5
2R<= 1m	1	4	0.707R	–	–	–	–
1< 2R<=2m	2	8	0.500R	0.866R	–	–	–
2< 2R<=4m	3	12	0.408R	0.707R	0.913R	–	–
4< 2R<=4.5m	4	16	0.354R	0.612R	0.791R	0.935R	–
4.5m< 2R	5	20	0.316R	0.548R	0.707R	0.837R	0.949R

Measurement points for rectangular and square cross section

Applicable duct cross section, A (m2)	Length of a sectioned side, L (m)
A<= 1m2	L≦0.5
1< A<=4m2	L≦0.667
4< A<=20m2	L≦1

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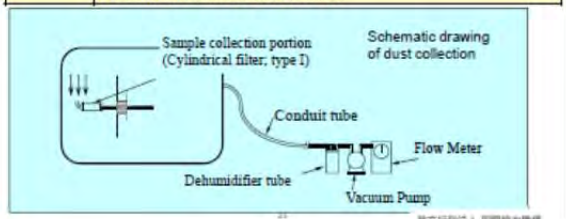
On-site Stack Gas Measurements
- Dust measurement -

- soot and dust concentration -

Outline	- The suction nozzle equipment should be inserted into the duct through the measurement holes. - Put of the suction nozzle to the designated place, and apply an **iso-kinetic sampling method**. - Dust concentration can be calculated



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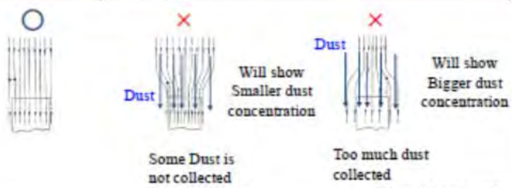
On-site Stack Gas Measurements
- Dust measurement -

- soot and dust concentration -

Iso-kinetic sampling	Suction nozzle must be faced to the exhaust gas flow, and the flow velocity of the suction gas flow rate must be adjusted to be equal to the flow velocity of the exhaust gas at the measurement point. The first thing to do is to know the flow velocity of the exhaust gas.



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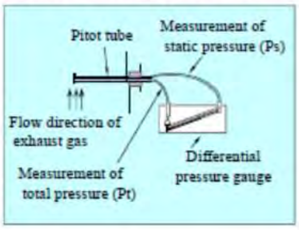
On-site Stack Gas Measurements
- Dust measurement -

- To know the velocity with using Pitot tube -

Bernoulli Equation

$$Pt = Ps + \frac{1}{2*g} \times \rho_m \times v_m^2$$

Pt : total pressure
Ps: static pressure
½ * ρ_m*v_m^2 : dynamic pressure
ρ_m: specific density at actual state
v_m: actual velocity
g: gravitational acceleration (9.81 m/s^2)



$$v_m = \sqrt{\frac{2 \times g}{\rho_m} \times (Pt - Ps)}$$

You can measure Pt, Ps, but you have to know ρ_m.

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On-site Stack Gas Measurements
- Dust measurement -

- To know the velocity with using Pitot tube -

What is the Bernoulli Equation

$$Pt = Ps + \frac{1}{2*g} \times \rho_m \times v_m^2$$

What is static pressure? Ps

Pressure that is applied by the air (gas) in static condition

What is dynamic pressure? $\frac{1}{2*g} \times \rho_m \times v_m^2$

Pressure that is generated by the flow velocity of the (exhaust) gas and exists facing the flow direction of the gas

What is total pressure? Pt

Total pressure is the pressure that the (exhaust) gas possesses and that is equal to (static pressure + dynamic pressure).

On-site Stack Gas Measurements
- Dust measurement -

- In order to know ρ_m (1/2) -

$$\rho_m = \rho_n \times \frac{273}{273+T_m} \times \frac{P_{ambient} + Ps}{101.3}$$

ρ_n: specific density (normal state: 0℃, 1 atm)
T_m: Exhaust gas temperature (℃)
$P_{ambient}$: Atmospheric pressure

$$\rho_n = \frac{1}{22.4 \times 100}\left[\left(44 \times CO_2 + 32 \times O_2 + 28 \times N_2\right)\left(1 - \frac{Moisture}{100}\right) + 18 \times Moisture\right]$$

Dry gas / Moisture

CO_2: %, O_2: %, N_2: %:
composition of exhaust gas (dry state **excluding moisture**)
Moisture content: %

On-site Stack Gas Measurements
- Dust measurement -

- In order to know ρ_m (2/2) -

Note

Normal state: (0°C, 1 atm)

Volume of 1 mole of any gas at the normal state is 22.4 L.
Mole: Unit of the amount of substance.
1 mole of C is 12 g and 1 mole of H_2O is 18 g.
1 mole of exhaust gas exists, and the density can be calculated by "weight (kg) / volume (m^3)".

In order to calculate v_m: $v_m = \sqrt{\frac{2 \times g}{\rho_m} \times (Pt - Ps)}$

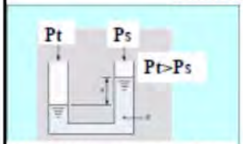
Requires

Gas composition CO_2, O_2, N_2: %, (dry state **excluding moisture**)
Moisture content: %

On-site Stack Gas Measurements
- Dust measurement -

- Measurement (Pt-Ps) -

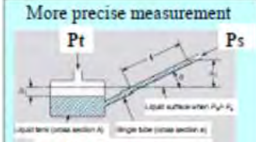
Differential pressure gauge



Liquid column manometer

$Pt - Ps = \rho gh$

More precise measurement



Inclined manometer

$Pt - Ps = \rho gL\sin\theta$

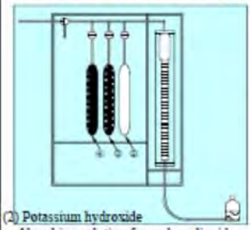
where, unit of Pt and Ps is Pa(kg/m²), ρ is liquid density (1,000 kg/m³ for water), g is gravitational acceleration (9.81 m/s²) and unit of h is m.

On-site Stack Gas Measurements
- Dust measurement -

- Measurement gas composition: CO2, O2, N2 -

the Olsat gas analyzer

Analysis method of the sample gas



(2) Potassium hydroxide
Absorbing solution for carbon dioxide
(3) (4) Pyrogallol + Potassium hydroxide
Absorbing solution for oxygen

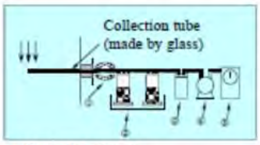
I. CO2 in exhaust gas is absorbed into potassium hydroxide solution.
$CO_2 + 2KOH \rightarrow K_2CO_3 + H_2O$
CO2 concentration can be known.
↓
II. O2 in the exhaust gas is absorbed into alkaline pyrogallol solution.
O_2 concentration can be known.
↓
III. N2 concentration can be calculated by using the equation: $100 - (CO_2 + O_2)$.

*)When CO exists, it uses 2[Cu(NH3)4]Cl)

On-site Stack Gas Measurements
- Dust measurement -

- Measurement gas moisture content (1/4) -

moisture absorption bottles (anhydrous calcium chloride)



No leak should be allowed at any connections of the equipment.

(1) Heating section
(2) Moisture absorbing bottle
(3) Dehumidifier tube
(4) Pump
(5) Meter

Weighing of absorbing bottle enables to calculate gas moisture content.

On-site Stack Gas Measurements
- Dust measurement -

- Measurement gas moisture content (2/4) -
moisture absorption bottles (anhydrous calcium chloride)

Measurement method

(1) Preparation for measurement

(a) Handling of moisture absorbing bottle

Remove dirt and other substances on the surface of the moisture absorbing bottle

Weighing the bottle accurately. (up to two places of decimals).

(b) Thermal insulation

Insulate of the connecting portion between the collection tube and the moisture absorbing bottle.

*)It is intended to prevent the exhaust gas from condensing at the collecting tube before the moisture reaches absorbing bottle due to cooling.

(2)Measurement

After the confirmation of the sufficient replacement of the exhaust gas including thermal insulation, suction of the exhaust gas can start.

(suction rate; 1 L/min to 2 L/min, duration of 5 to 10 min 独立行政法人 国際協力機構 e needs to be determined for the absorbed moisture to be between 0.1 g to 1 g

On-site Stack Gas Measurements
- Dust measurement -

-Measurement gas moisture content (3/4) -
moisture absorption bottles (anhydrous calcium chloride)

Recording: temperature, pressure and volume of the suction gas

Calculation is the following equation.

$$X_w = \frac{\text{Water volume}}{\text{Gas volume} + \text{Water volume}} \times 100$$

The detailed equation is in the next page.

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On-site Stack Gas Measurements
- Dust measurement -

-Measurement gas moisture content (4/4) -
moisture absorption bottles (anhydrous calcium chloride)

$$X_w = \frac{\frac{22.4}{18} m_a}{Vm \times \frac{273}{273+\theta_m} \times \frac{P_a + P_m - P_v}{101.3} + \frac{22.4}{18} m_a} \times 100$$

This is the conversion of moisture weight in the collected gas into the volume at the normal state.

This is the volume of the suction gas at normal state (0°C, 1 atm) by dry base.

Vm: Suction volume (L)

θm: Gas temperature at the meter (°C)

Pa: Atmospheric pressure (kPa)

Pm: Gas pressure at the meter (kPa)

Pv: Saturated vapor pressure at gas temperature at the meter (kPa)

m_a: Mass of moisture (g)

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On-site Stack Gas Measurements
- Dust measurement -

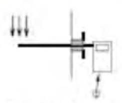
- Measurement of exhaust gas temperature -
Thermometer (Thermo-couples)

-Measurement needs to be performed by inserting a thermometer into the exhaust gas duct.

↓

Measurement

After waiting for the stabilization of the temperature of the exhaust gas, gas temperature must be recorded.



Temperature monitor

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On-site Stack Gas Measurements
- Dust measurement -

- Calculation of suction volume -
You can calculate actual velocity.

$$v_a = \sqrt{\frac{2 \times g}{\rho_a} \times (Pt - Ps)} \qquad \rho_a = \rho_n \times \frac{273}{273+T_a} \times \frac{P_{ambient} + Ps}{101.3}$$

You can calculate suction volume for Iso-kinetic sampling.

(1) Flow velocity of exhaust gas: m/s

(2) Nozzle diameter: mm, Moisture: %

(3) Exhaust gas temperature: °C, Gas temperature at the meter: °C

(4) Static pressure of exhaust gas: kPa, Atmospheric pressure : kPa

(5) Gas pressure at the meter: kPa, Saturated vapor pressure at °C: kPa

Last step is to calculate suction volume.

$$\text{Suction volume} = \frac{\pi}{4} \times \text{Nozzle diameter}^2 \times \left(1 - \frac{\text{Moisture}}{100}\right) \times \frac{273 + \text{Gas temperature at the meter}}{273 + \text{Exhaust gas temperature}} \times \frac{\text{Atmospheric pressure} + \text{Static pressure}}{\text{Atmospheric pressure} + \text{Gas pressure at the meter} - \text{Saturated vapor pressure}} \times \text{Flow velocity} \times 60 \times 10^{-3}$$

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On-site Stack Gas Measurements
- Dust measurement -

- Calculation of dust concentration -
"Calculation of suction gas volume"

(1)Record the start and finish time

(2)Read the gas meter scale up to 0.1 L unit (before and after the measurement).

(3)Measure the Temperature and pressure of the suction gas at the gas meter during the suction period.

$$V_N = V_{gm} \times \frac{273}{273 + \theta_{gm}} \times \frac{P_a + P_{gm} - P_v}{101.3} \times 10^{-3}$$

V_N: Suctioned dry gas volume at the normal state (m^3_N)

V_{gm}: Suctioned gas volume (m^3) obtained by the reading of the wet gas meter

θ_{gm}: Suction gas temperature at the gas meter (°C)

Pa: Atmospheric pressure (kPa)

P_{gm}: Gas pressure expressed by gauge pressure at the gas meter (kPa)

Pv: Saturated vapor pressure at θm (kPa)

"Calculation of dust concentration"

(4) Dust concentration in the exhaust gas can be expressed by the mass of dust contained in 1 m3 of dry exhaust gas converted to the standard condition.

$$C = \frac{m_d}{V_N}$$

C: Dust concentration in the dry exhaust gas at the standard condition (g/m^3_N)

m_d: Mass of collected dust (g)

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On-site Stack Gas Measurements
- Dust measurement -

- Conversion to the emission value -

If the O_2 content in the exhaust gas is different, the concentration value of dust changes, even tough the total amount of dust is same.
Finally the value must be converted to the value at reference O_2 content

$$C_e = \frac{(21-O_{2e})}{(21-O_2)} \times C$$

Ce : the emission value [g/m3N]
O_{2e} : reference O_2 content [%] (dry state)
In EU Directive 3% in case of liquid and gaseous fuels
6% in case of solid fuels
O_2 : actual O2 content [%] (dry state)
C : measured value [g/m3N]

On-site Stack Gas Measurements
- Dust measurement -

- Conversion to the emission value -

The meaning of the conversion equation is as follows

$$C_e = \frac{(21-O_{2e})}{(21-O_2)} \times C$$

Ve
Vn

Ve+Vn= total gas volume (m3N)
Ve: gas volume at O_{2e} (m3N)
Vn: Air (m3N) O2=21%

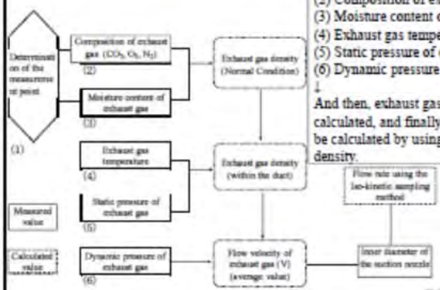
- the amount of the dust is the same
  C × (Ve+Vn)=Ce × Ve
- O2 balance
  Ve × O_{2e} /100+Vn × 21/100 = (Ve+Vn) × O_2 ⟶ $V_n = \frac{(O_2-O_{2e})}{(21-O_2)} \times V_e$

$$C_e = \frac{V_e+V_n}{V_e} \times C = \left[1+\frac{(O_2-O_{2e})}{(21-O_2)}\right] \times C = \frac{(21-O_{2e})}{(21-O_2)} \times C$$

On-site Stack Gas Measurements
- Dust measurement -

- Summery -

In order to calculate the flow velocity of the exhaust gas, the following items are required
(2) Composition of exhaust gas
(3) Moisture content of exhaust gas
(4) Exhaust gas temperature
(5) Static pressure of exhaust gas
(6) Dynamic pressure of exhaust gas.
↓
And then, exhaust gas density needs to be calculated, and finally the gas velocity can be calculated by using the exhaust gas density.



On-site Stack Gas Measurements
- Dust measurement -

- Reference -

- Exhaust gas Measurement method of the concentration of soot and dust -

Dust sample collection equipment is classified into 2 types:
manual sample collection equipment and automatic sample collection equipment.

○ Manual sample collection equipment: Flow velocity of the gas is calculated manually and the sampling flow velocity is manually adjusted.
This corresponds to the equipment that has been explained in the course.

○ Automatic sample collection equipment: Flow velocity of the gas is calculated automatically by a machine and the sampling flow velocity is adjusted automatically by a machine according to the actual varied flow velocity.

Attention on on-site stack gas measurement

Attention on on-site stack gas measurement

- Measurement Point -

Uniform flow allows, if the uniformity is confirmed.
-To decrease the measurement points
-To take a gas and water content sample, and temperature from any place in the duct

Safety and equipment are very important
- Stairways (caring about aging)
- handrails (caring about aging)
- power supply
-lightning, etc.

Attention on on-site stack gas measurement

- Dust Trial -

No one knows how much dust in the exhaust gas.
-**Dust trial** is one way to confirm the suction volume.
Suction volume must be determined by the concentration of soot and dust in the exhaust gas.

Suction volume (m3/min)
= **Cross sectional are of the nozzle** (m2) x Flow velocity (m/min) x **Sampling time**

- ○ Large amount of soot and dust: Small suction volume
  Small nozzle and short sampling time
- ○ Small amount of soot and dust: Large suction volume
  Big nozzle and long sampling time

Attention on on-site stack gas measurement

Boiler Operation During Gas Measurement

- Boiler Load should be Stable
- Coal should be Same Quality
- Air Flow should be Constant
- Soot Blowing should be Stopped

↓

Should be Checked before Start and During of on-site stack Gas Measurement

Attention on on-site stack gas measurement

- Sulfur Content in Coal affects on SOx Concentration
- Nitrogen Content in Coal affects on NOx Generation
- Ash Content in Coal and Unburned Carbon affects on Dust Loading
- Excess Air (O2 in Flue gas) affects on
  - Unburned Carbon, CO Generation
  - NOx Generation
  - Flue Gas Flow → ESP Efficiency

Attention on on-site stack gas measurement

At least following Boiler Operation Data should be Recorded and Attached to on-site stack gas measurement Result

1. Boiler Load (Steam Flow)
2. Steam Pressure and Temperature
3. Coal Flow
4. Air Flow (O2; if O2 meter is available)
5. Ambient Air Temperature and Humidity
6. FD Fan outlet Air and ID Fan inlet Gas Pressure

Attention on on-site stack gas measurement

Analysis of **Coal, bottom ash, and fly ash** are planned to help analysis of boiler condition.

- Coal Analysis
  - Proximate Analysis
    Moisture, Volatile matter, Fixed carbon, Ash, Sulfur
  - Ultimate Analysis
    Carbon, Hydrogen, Nitrogen, Oxygen, Sulfur, Ash
  - Higher Heating Value

Thank you for your cooperation

２－２－３　ワークショップ資料（アルバニア語版）

Ekspert për Kontrollin e Ndotjes së Ajrit
Punëtoria për

Matjen dhe Analizën e Shkarkimit të Gazit në Japoni
(Në mjedisin ajror)

Ekipi i Misionit i JICA-s
21 tetor 2015
në Ministrinë e Mjedisit dhe Planifikimit Hapësinor

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- Orientimi -

Hyrje
- Historia e ndotjes së mjedisit në Japoni
- Përparimi i legjislacionit të ndërlidhur me mjedisin
- Mekanizmat e gjenerimit të blozës dhe pluhurit, SOx, dhe NOx
- Metodat e mënjanimit të blozës dhe pluhurit, SOx, dhe NOx

Matjet në Terren të Gazit në Masë
- **Matja e pluhurit** -
në Standardet Industriale të Japonisë (metoda JIS) dhe teknikat e analizës
- Matjet në terren të gazit në masë
në Aktin për Kontrollin e Ndotjes së Ajrit (Pluhuri)

Vëmendja në matjet në terren të gazit në masë

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Hyrje

- Historia e ndotjes së mjedisit në Japoni
- Përparimi i legjislacionit të ndërlidhur me mjedisin
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Historia e ndotjes së mjedisit në Japoni

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4 ndotjet kryesore në Japoni

- të shkaktuara nga ndotja e mjedisit -

1. 'Sëmundja itai-itai' helmimi me Cd

Nga viti 1910 deri në fillim të viteve 1970ta,
Kadmiumi nga fabrika për rafinimin e zinkut ka rrjedhë në një lum lokal.
Njerëzit e marrin Cd përmes ujit, produkteve bujqësore, etj.

(Simptomat)
Dëmtimi i veshkave dhe Osteomalacia (zbutja e eshtrave)
Eshtrat fillojnë të zbuten dhe thyhen në pjesë të ndryshme të trupit.
Dhe pacientët bërtasin "Itai, itai (uf-uf)",
Prandaj është emëruar "Sëmundja itai-itai".

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4 ndotjet kryesore në Japoni

- të shkaktuara nga ndotja e mjedisit -

2. 3. "Sëmundja Minamata" (helmimi me metilen të merkurit)
Në vitin 1956, ndodhi e 1rа dhe në vitin 1965, ndodhi e 2ta.
Të dyja erdhën nga prodhimi i ethanalit (CH_3CHO) për prodhiminn e plehrave artificialë

(Simptomat)
Metileni i merkurit i futur përmes ushqimit në organizëm e bën të paaftë trurin dhe sistemin nervor
→Ndjenja në gjymtyrë bëhet e mpirë. Ata të cilët u bënë jashtëzakonisht të paaftë u kapën nga ngërçet dhe disa nga ta vdiqën.

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4 ndotjet kryesore në Japoni

- të shkaktuara nga ndotja e mjedisit -

4. "Astma Yokkaichi"(**ndotja me gaz të acidit të sulfurit**)
Kjo astmë filloi që nga viti 1961.
Kompleksi petrokimik, etj.,që ka përdorur naftë ka emetuar një sasi të madhe të gazit të acidit sulfurik në ajër



Yokkaichi në vitet e 1960'ta   Yokkaichi Sot

(Simptomat)
Kur të thithen oksidet e sulfurit, kjo krijon pezmatim të membranës së mukozës në rrugën e frymëmarrjes. Kur sasia e oksidit të sulfurit ndaj së cilës ekspozohemi shkakton sëmundje të frymëmarrjes siç është astma bronkiale.

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Një Çështje Tjetër Mjedisore

- Ndotja e Ajrit në Kinë -

Ndotja e ajrit në Kinë është bërë një problem i madh shoqëror në Kinë, kryesisht e shkaktuar nga shkarkimi i gazit nga automjetet, dhe **PM2.5 dhe PM10** nga impiantet për prodhimin e energjisë elektrike dhe për ngrohjen e zonave të qarkut që përdorin qymyrin.


Në Kinë, nga raporti i OBSh-së në vitin 2014,
është thënë se 38% të njerëzve në Kinë jetojnë në zona jo të shëndetshme me një nivel të papërshtatshëm atmosferik.
Shumë njerëz mund të vdesin nga sëmundjet e zemrës dhe të ushkërive, apopleksia (sulmi), etj., të shkaktuara nga ndotja e ajrit.

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Një Çështje Tjetër Mjedisore

- Smogu fotokimik kryesisht i shkaktuar nga NOx, O_3, etj. - (Smogu = tymi + mjegulla)

Grimcat e imëta të oksidantit fotokimik të përbërësit të gazit që përbëhet nga ozoni ose aldehidi (R-CHO), dhe përbërësi solid i përbërë nga përzierja nitrike ose e sulfateve

(Simptomat)
Oksidanti fotokimik shkakton ngacmim të syve, fytit dhe lëkurës përmes përbërësve të oksidantëve fotokimikë.

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Përparimi i legjislacioneve të lidhura me mjedisin

Viti	Emri i ligjit	Vërejtjet
1958	Ligji për Kontrollin e ujërave të zeza nga fabrikat	
1962	Ligji për Kontrollin e Emetimit	
1967	Akti për Parandalimin e Ndotjes së Mjedisit	Korrespondon me problemet mjedisore
1968	Ligji për Kontrollin e Ndotjes së Ajrit	Korrespondon me problemet e ndotjes së ajrit
1970	Ligji për Kontrollin e Ndotjes së Ujit	Korrespondon me problemet e ndotjes së ujit
1971~	Ligjet individuale	Kundërmimi, zhurma, dridhjet, etj
1993	Akti Themelor për Mjedisin	Për të përballuar problemet më të gjera duke përfshirë mjedisin global

Standardet mjedisore për ajrin

- Ligji për Kontrollin e Ndotjes së Ajrit

Substanca	Vlera Standarde
SO_2 (Dyoksidi i sulfurit)	<=0.04 ppm: vlera mesatare ditore <=0.1 ppm: vlera mesatare në orë
CO (Monoksidi i karbonit)	<=10 ppm: vlera mesatare ditore <=20 ppm: vlera mesatare në orë
Materia grimcë e pezulluar (SPM)	<=0.1 mg/m^3: Vlera mesatare ditore <=0.2 mg/m^3: vlera mesatare në orë
Dyoksidi i Azotit (NO_2)	0.04 ppm deri 0.06 ppm: vlera mesatare ditore
Oksidantët fotokimikë	<=0,06 ppm: vlera mesatare në orë

Standardet janë përcaktuar edhe për substanca të tjera, duke përfshirë benzenin, trikloretilenin, tetrakloretilenin, diklorometanin, dioksinat, dhe materiet grimca të imëta.

独立行政法人 国際協力機構

Standardet e emetimit (ajri)

- Ligji për Kontrollin e Ndotjes së Ajrit -

Vlerat janë të ndryshme varësisht nga shkalla dhe lloji i instalacioneve.
Për shembull:

Lloji i instalacionit (32 lloje)	Shkalla (Vëllimi i gazit të shkarkuar)	Vlera e kontrolluar e blozës dhe pluhurit	Vlera e kontrolluar e NOx
Kazani i Qymyrit	>=200,000 m^3	0.1g/m3	200 deri 250ppm
	200,000m^3>=>=40,000	0.2g/m3	250 deri 320ppm
	40,000 m^3>=	0.3g/m3	250 deri 350ppm
Djegësi i mbeturinave	>=4ton/orë	0.04g/m3	250 deri 700ppm
	4ton/orë>= >=2ton/h	0.08g/m3	
	2ton/orë>=	0.15g/m3	

独立行政法人 国際協力機構

Bloza dhe pluhuri, SOx dhe NOx

Mekanizmi i gjenerimit

Substanca	Mekanizmi i gjenerimit
Bloza dhe pluhuri	- Hiri që fluturon në ajër gjenerohet përmes djegies - Substancat (materiet metalike, etj.) gazifikohen dhe ngurtësohen gjatë procesit të ftohjes së gazit të shkarkuar. - Bloza gjenerohet nga djegia jo e plotë e hidrokarbureve të paqëndrueshme.
SOx (Oksidet e sulfurit)	gjenerohen përmes oksidimit të sulfurit në lëndë djegëse. $SOx = SO_2 + SO_3$: Thuhet se SO_3 në SOx është 2~3 %.
NOx (oksidet e azotit)	NOx lënda djegëse + NOx Termike -NOx lëndë djegëse: djegia e azotit në lëndën djegëse -NOx lëndë djegëse: reaksioni me azotin në ajrin e djegies (e gjeneruar në pjesën me temperaturë të lartë të flakës)

Bloza dhe pluhuri, SOx dhe NOx

Metodat e mënjanimit dhe mekanizmat e saj

Substanca	Metodat e mënjanimit	Mekanizmat për mënjanim
Bloza dhe pluhuri	Mbledhësi i pluhurit përmes qeseve filtruese	Filtrat e gazit të shkarkuar me pëlhura me fibër
	Aparati elektrostatik për fundërrina	Mbledh grimcat e blozës në gazin e shkarkuar përreth elektrodës grumbulluese duke e ngarkuar me një voltazh të lartë.
SOx (oksidet e sulfurit)	Shtesë e agjentit neutralizues	Shtimi i alkalineve (hidroksidi i kalciumit) mënjanon SOx si sulfite të kalciumit (gips). $SO_{2\text{-}3} + Ca(OH)_2 \rightarrow CaSO_4 + H_2O$
NOx (oksidet e azotit)	Mënjanimi i NOx me anë të katalizatorëve	NOx mënjanohet përmes reaksionit kimik në mes oksideve të amoniakut dhe azotit në rreth 300°C me anë të katalizatorit. $4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$

Matja në Terren e Gazit në Masë

- **Matja e pluhurit** -

Në Standardet Industriale Japoneze (metoda JIS: JIS Z 8808) dhe teknikat e analizës

・Matja në terren e gazit në masë

në Aktin për Kontrollin e Ndotjes së Ajrit (Pluhuri)

14 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë

- Qëllimi i matjeve -

1. Matjet ligjore, matjet vullnetare
- Kontrollimi i vëzhgimit të kufizimeve rregullative
- Raportimi i vlerave të emetuar tek organizata
- Publikimi i të dhënave për emetimin tek komuniteti

2. Menaxhimi i impiantit
- Vlerësimi i kushteve të emetimit dhe analizimi i kushteve të operimit të impiantit.
- Gjykimi i kushteve të operimit të instalacioneve për kontrollimin e emetimit
- Gjykimi i kushteve mekanike të instalacioneve për kontrollimin e emetimit

⇒ Studimi për përmirësimin e operimit, mirëmbajtjes, riorganizimit, etj., të impiantit

15 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë

Përmbledhja e matjes ・ metoda e analizës

①Metoda e marrjes së mostrës së gazit
- ・Metoda e marrjes së mostrës së filtrimit ・・・・ Pluhuri, Metalet, etj
- ・Metoda e marrjes së mostrës në mënyrë të drejtpërdrejt ・・・・・ Gazi inert (O2, CO2 etj)
- ・Metoda e marrjes së mostrës së likuidit ・・・・・ HCl, SOx, NOx, etj

②Metoda solide, likuide
- ・Metoda e marrjes së mostrës drejtpërdrejt ・・・・・ Marrja e mostrës në mënyrë të rastësishme, Marrja e mostrës së shtresimit, Shpërndarja e Reduktuar etj.

③Metoda e analizës
- ・Metoda e peshimit ・・・・・・・ Gazi i shkarkuar në pluhur, lagështi etj.
- ・Fotometria absorbuese (AAS) ・ NH3, HCN, Cr^{+6}, NOx, SO, etj.
- ・Spektrofotometria e Absorbimit Atomik (AA) ・・Pb, Cd, Hg, Cr, As, Se, Mn, Cu, Fe, etj
- Analiza spektrometrike e emetimit të plazmës me frekuencë të lartë/ (Spektrometri në masë) ICP/MS
- ・Kromatografi i Jonit (IC) ・ Anionit (F, NO_3, SO_4, etj.) Kationit (Na, K, NH_3 etj.)
- ・Kromatografi i Gazit/ (Spektrometri në masë) GC/(MS) ・・・・・・ Gazi jo-organik, Gazi jo-organik i pa-degradueshëm, PCB, dioksinat
- ・Kromatografi likuid me performancë të lartë (HPLC) ・・・・・ Materiet organike të degradueshme (të tretshëm në ujë)
- ・Kromatografi i likuidit/ (Spektrometri në masë) LC/(MS) ・・・・・ Materiet organike të degradueshme me polimer të lartë (të tretshëm në ujë)

16 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë

Pajisjet matëse analizuese

Kromatografi i Jonit (IC)

Fotometria e absorbimit (AAS)

Analizuesi Orsat

Analizuesi i automatizuar i CO, CO2, O2, NOx, SO2

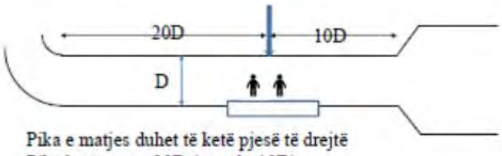
Nga faqja tjetër

Fillojnë Ligjërimet për matjen e pluhurit

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Ligjërimet për matjen e pluhurit -
- Përcaktimi i pikës së matjes -

Pika e matjes duhet të ketë rrjedhë uniforme



Pika e matjes duhet të ketë pjesë të drejtë
Pika hyrëse >= 20D (së paku10D)
Pika dalëse>= 10D (së paku 5D)
(Kjo gjatësi është e njëjtë si standardi për instalimin e njehsorit të rrjedhës)

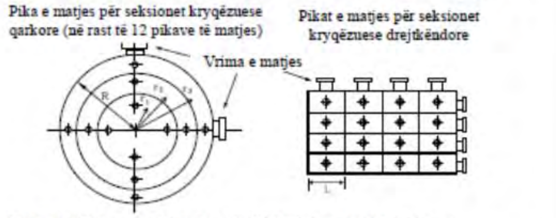
独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Përcaktimi i pikës së matjes -

Pikat e matjes duhet të zgjedhen varësisht nga madhësia dhe forma e seksionit kryqëzues të gypit.

Pikat e matjes janë qendra e të njëjtës zonë të seksioneve kryqëzuese.



Kur gypi është me madhësi të vogël (0.25 m² ose më pak në seksioni kryqëzues), pika qendrore mund të caktohet si pikë e matjes.

独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Përcaktimi i pikës së matjes -

Tabelat në vijim tregojnë pikat e matjes për gypa të mëdhenj.

Pikat e matjes për seksionet kryqëzuese qarkore

Diametri i ... i gypit 2R (m)	Numri i seksioneve	Numri i pikave të matjes	r_1	r_2	r_3	r_4	r_5
2R<= 1m	1	4	0.7070	–	–	–	–
1< 2R<=2m	2	8	0.5000	0.8660	–	–	–
2< 2R<=4m	3	12	0.4083	0.7070	0.9130	–	–
4< 2R<=4.5m	4	16	0.3540	0.6120	0.7910	0.9350	–
4.5m< 2R	5	20	0.3160	0.5480	0.7070	0.8370	0.9490

Pikat e matjes për seksionet kryqëzuese drejtkëndore dhe katrore

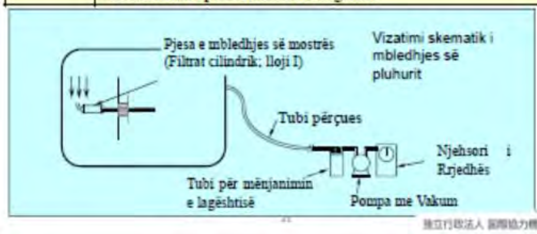
Seksioni kryqëzues i ... i gypit, A (m2)	Gjatësia e ... seksionit, L (m)
A<= 1m2	L≤0.5
1< A<=4m2	L≤0.667
4< A<=20m2	L≤1

30 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- koncentrimet e blozës dhe pluhurit

Pasqyra	- Pajisja me grykë thithëse duhet të futet në gyp përmes vrimave të matjes. - Vendosni grykën thithëse në vendin e përcaktuar, dhe aplikoni **metodën e marrjes së mostrës në mënyrë iso-kinetike**. - Koncentrimi i pluhurit mund të llogaritet

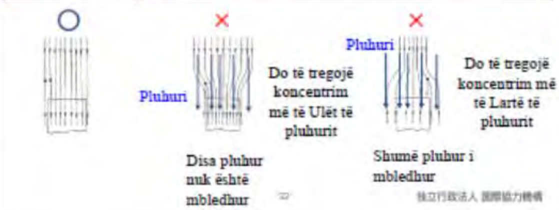


独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- koncentrimet e blozës dhe pluhurit -

Marrja e mostrës në mënyrë iso-kinetike	Gryka thithëse duhet të jetë e drejtuar nga rrjedha e gazit të shkarkuar, dhe shpejtësia e rrjedhës së normës së rrjedhës së gazit të thithur duhet të përshtatet me shpejtësinë e rrjedhës së gazit të shkarkuar në pikën e matjes. Gjëja e parë që duhet ditur është shpejtësia e rrjedhës së gazit të shkarkuar.



独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

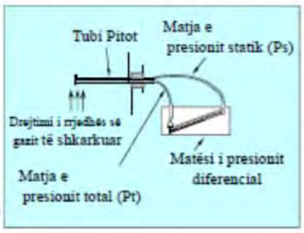
- Të mësojmë shpejtësinë me përdorimin e tubit Pitot

Ekuacioni i

$$Pt = Ps + \frac{1}{2*g} \times \rho_m \times v_m^2$$

Pt: presioni total
Ps: presioni statik
$½ * \rho_m * v_m^2$: presioni dinamik
ρ_m: densiteti specifik në gjendjen aktuale
v_m: shpejtësia aktuale
g: përshpejtimi gravitacional (9.81 m/s²)

$$v_m = \sqrt{\frac{2 \times g}{\rho_m} \times (Pt - Ps)}$$



Ju mund të matni Pt, Ps, por duhet të dini ρ_m.

独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Të dijmë shpejtësinë me përdorimin e tubit Pitot

Çka është Ekuacioni i Bernoullit

$$Pt = Ps + \frac{1}{2*g} \times \rho_m \times v_m^2$$

Çka është presioni statik? Ps

Presioni që aplikohet nga ajri (gazi) në gjendje statike

Çka është presioni dinamik? $\frac{1}{2*g} \times \rho_m \times v_m^2$

Presion që gjenerohet nga shpejtësia e rrjedhës të gazit (të shkarkuar) dhe ekziston përballë drejtimit të rrjedhës së gazit

Çka është presioni total? Pt

Presioni total është presioni që gazi (i shkarkuar) posedon dhe është i barabartë me (presionin statik + presionin dinamik).

24 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Për të mësuar ρ_m (1/2) -

$$\rho_m = \rho_n \times \frac{273}{273 + T_m} \times \frac{P_{ambient} + Ps}{101.3}$$

ρ_n: dendësia specifike (gjendja normale: 0℃, 1 atm)

T_m: Temperatura e gazit të shkarkuar (℃)

$P_{ambient}$: Presioni atmosferik

$$\rho_n = \frac{1}{22.4 \times 100}\left[\left(44 \times CO_2 + 32 \times O_2 + 28 \times N_2\right)\left(1 - \frac{Moisture}{100}\right) + 18 \times Moisture\right]$$

Gazi i tharë — Lagështia

CO_2: %, O_2: %, N_2: %:

përbërja e gazit të shkarkuar (gjendja e tharë **duke përjashtuar lagështinë**)

Përbërja e lagështisë: %

25 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Për të mësuar ρ_m (2/2) -

Shënim

Gjendja normale: (0°C, 1 atm)

Vëllimi i 1 moli i çfarëdo gazi në gjendje normal është 22.4 L.

Moli: Njësia e sasisë së substancës.

1 mol i C është 12 g dhe 1 mol i H_2O është 18 g.

1 mol i gazit të shkarkuar ekziston, dhe dendësia e tij mund të llogaritet përmes "pesha (kg)/vëllimi (m^3)",

Për të llogaritur v_m: $v_m = \sqrt{\frac{2 \times g}{\rho_m} \times (Pt - Ps)}$

Kërkon

Përbërjen e Gazit CO_2, O_2, N_2: %, (gjendja e tharë **duke përjashtuar lagështinë**)

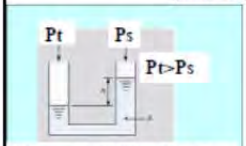
Përbërja e lagështisë: %

26 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Matjet (Pt-Ps)

Matësi i presionit diferencial



Manometri i shtyllës së lëngut

$Pt - Ps = \rho gh$

Matje më e saktë

Manometri i pjerrët

$Pt - Ps = \rho gL\sin\theta$

ku, njësia e Pt dhe Ps është Pa(kg/m^2), ρ është dendësia e lëngut (1,000 kg/m^3 për ujë), g është përshpejtimi gravitacional (9.81 m/s^2) dhe njësia e h është m.

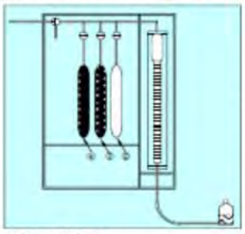
27 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Përbërja e gazit nga matja: CO2, O2, N2 -

Analizuesi i gazit Olsat

Metoda e analizës së gazit mostër



(2) Hidroksidi i kaliumit
Solucion absorbues për dyoksidin e karbonit
(3) (4) Pirogalloli + Hidroksidi i kaliumit
Solucion absorbues për oksigjenin

I. CO2 në gazin e shkarkuar absorbohet në solucion të hidroksidit të kaliumit.
$CO_2 + 2KOH \rightarrow K_2CO_3 + H_2O$
koncentrimi i CO2 mund të dihet.
↓
II. O2 në gazin e shkarkuar absorbohet në solucion të piragallolit bazik
Koncentrimi i O_2 mund të dihet.
↓
III. Koncentrimi i N2 mund të llogaritet duke përdorur ekuacionin: $100 - (CO_2 + O_2)$.

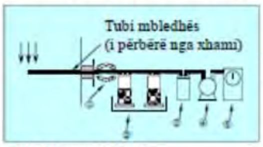
*)Kur CO ekziston, ajo shfrytëzon 2[Cu(NH3)4]Cl)

28 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Përbërja e lagështisë së gazit të matur (1/4) -

Bocat për absorbimin e lagështisë (Klorid kalciumi i paujë)



Nuk duhet të lejohet rrjedhje në asnjë lidhje të pajisjeve.

(1) Seksioni i ngrohjes
(2) Boca për absorbimin e lagështisë
(3) Tubi për mënjanimin e lagështisë
(4) Pompa
(5) Njehsori

Matja e peshës së bocës absorbuese mundëson llogaritjen e përbërjes së lagështisë së gazit.

29 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Përbërja e lagështisë së gazit të matur (2/4) -
bocat për absorbimin e lagështisë (klorid i kalciumit i paujë)

Metoda e matjes

(1) Përgatitja për matje

(A) Trajtimi i bocës për absorbimin e lagështisë

Mënjanoni pluhurin dhe substancat e tjera nga sipërfaqja e bocës për absorbimin e lagështisë

Matja e saktë e peshës së bocës. (Deri në dy hapësira decimale).

(b) Izolimi termal

Izolimi i pjesës lidhëse në mes tubit mbledhës dhe bocës për absorbimin e lagështisë.
*)Ka për qëllim parandalimin e gazit të shkarkuar nga kondensimi në tubin mbledhës para se lagështia të arrijë bocën absorbuese si rezultat i ftohjes.

(2)Matja

Pas konfirmimit të zëvendësimit të mjaftueshëm të gazit të shkarkuar duke përfshirë izolimin termal, mund të fillojë thithja e gazit të shkarkuar.

(Norma e thithjes; 1 L/min deri 2 L/min, kohëzgjatja 5 deri 10 minuta). Vëllimi i thithjes duhet të përcaktohet për lagështinë e absorbuar të jetë në mes 0.1 g deri 1 g.

30 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

-Përbërja e lagështisë së gazit të matur (3/4) -
bocat për absorbimin e lagështisë (Klorid kalciumi i paujë)

Regjistrimi: temperatura, presioni dhe vëllimi i gazit të shkarkuar

Llogaritja bëhet përmes ekuacionit në vijim.

$$X_w = \frac{\text{Vëllimi i ujit}}{\text{Vëllimi i gazit} + \text{Vëllimi i ujit}} \times 100$$

Ekuacioni i detajuar gjendet në faqen e ardhshme.

31 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

-Përbërja e lagështisë së gazit të matur (4/4) -
bocat për absorbimin e lagështisë (Klorid kalciumi i paujë)

$$X_w = \frac{\frac{22.4}{18} m_a}{Vm \times \frac{273}{273+\theta_m} \times \frac{P_a + P_m - P_v}{101.3} + \frac{22.4}{18} m_a} \times 100$$

Ky është konvertimi i peshës së lagështisë në gazin e mbledhur në vëllimin në gjendje normale.

Ky është vëllimi i gazit të thithur në gjendje normale (0°C, 1 atm) me bazë të tharë.

Vm: Vëllimi i thithjes (L)
θm: Temperatura e gazit në njehsor (° C)
Pa: Presioni atmosferik (kPa)
Pm: Presioni i gazit në njehsor (kPa)
Pv: Presioni i avullit të ngopur në temperaturën e gazit në njehsor (kPa)

m_a: Masa e lagështisë (g)

32 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

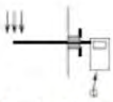
- Matja e temperaturës së gazit të shkarkuar
Termometri (Termo-çiftet)

- Matja duhet të bëhet përmes futjes së termometrit në gypin e gazit të shkarkuar.

↓

Matja

Pas pritjes për stabilizimin e temperaturës së gazit të shkarkuar, temperatura e gazit duhet të regjistrohet.



Monitori i temperaturës

33 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Llogaritja e vëllimit të thithjes -
Ju mund të llogaritni shpejtësinë aktuale.

$$v_a = \sqrt{\frac{2 \times g}{\rho_a} \times (\text{Pt} - \text{Ps})} \qquad \rho_a = \rho_n \times \frac{273}{273 + T_a} \times \frac{P_{ambient} + Ps}{101.3}$$

Ju mund të llogaritni vëllimin e thithjes për mostrën Iso-kinetike.

(1) Shpejtësia e rrjedhës së gazit të shkarkuar: m/s
(2) Diametri i grykës: mm, Lagështia: %
(3) Temperatura e gazit të shkarkuar: °C, Temperatura e gazit në njehsor: °C
(4) Presioni statik i gazit të shkarkuar: kPa, Presioni atmosferik:kPa
(5) Presioni i gazit në njehsor: kPa., Presioni i avullit të ngopur në °C: kPa

Hapi i fundit është llogaritja e vëllimit të thithjes.

$$\text{Thithja e vëllimit} = \frac{\pi}{4} \times \text{Diametri i grykës}^2 \times \left(1 - \frac{\text{Lagështia}}{100}\right) \times \frac{273 + \text{Temperatura e gazit në njehsor}}{273 + \text{Temperatura e gazit të shkarkuar}} \times \frac{\text{Presioni atmosferik} + \text{Presioni statik}}{\text{Presioni atmosferik} + \text{Presioni i gazit në njehsor} - \text{Presioni i avullit të ngopur}} \times \text{Shpejtësia e rrjedhës} \times 60 \times 10^{-3}$$

34 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Llogaritja e koncentrimit të pluhurit -
"Llogaritja e vëllimit të gazit të thithur"

(1)Regjistroni kohën e fillimit dhe mbarimit
(2)Lexojeni shkallën e njehsorit të gazit deri në njësinë 0.1 L (para dhe pas matjes).
(3) Mateni temperaturën dhe presionin e gazit të thithur në njehsorin e gazit Gjatë periudhës së thithjes.

$$V_N = V_{gm} \times \frac{273}{273 + \theta_{gm}} \times \frac{P_a + P_{gm} - P_v}{101.3} \times 10^{-3}$$

V_N: Vëllimi i gazit të tharë të thithur në gjendje normale (m^3_N)
V_{gm}: Vëllimi i gazit të thithur (m^3) i marrë përmes leximit të njehsorit të gazit të lagur
θ_{gm}: Temperatura e gazit të thithur në njehsorin e gazit(°C)
Pa: Presioni atmosferik (kPa)
P_{gm}: Presioni i gazit i shprehur përmes presionit të matësit në njehsor të gazit (kPa)
Pv: Presioni i avullit të ngopur në θm (kPa)

"Llogaritja e koncentrimit të pluhurit"

(4) Koncentrimi i pluhurit në gazin e shkarkuar mund të shprehet përmes masës së pluhurit të përmbajtur në 1 m3 të gazit të shkarkuar të tharë të konvertuar në gjendje standarde.

$$C = \frac{m_d}{V_N}$$

C: Koncentrimi i pluhurit në gazin e shkarkuar në gjendje standarde (g/m^3_N)
m_d: Masa e pluhurit të mbledhur (g)

独立行政法人 国際協力機構

Matja në terren e gazit në masë
- Matja e pluhurit -

- Konvertimi në vlera të emetimit -

Nëse përmbajtja e O_2 në gazin e shkarkuar është i ndryshëm, vlera e koncentrimit të pluhurit ndryshon, edhe pse sasia totale e pluhurit është e njëjtë.
Në fund vlera duhet të konvertohet në vlerë të referencës së përmbajtjes O_2

$$C_e = \frac{(21 - O_{2e})}{(21 - O_2)} \times C$$

Ce : vlera e emetimit [g/m3N]
O_{2e} : referenca e përmbajtjes O_2 [%] (gjendja e tharë)
Në Direktivën e BE-së 3% në rast të lëngut dhe lëndëve djegëse të gazta
6% në rast të lëndëve djegëse të ngurta
O_2 : përmbajtja aktuale O2 [%] (gjendja e tharë)
Ce : vlera e matur [g/m3N]

36 独立行政法人 国際協力機構

Matja në terren e gazit në masë
- Matja e pluhurit -

- Konvertimi në vlera të emetimit -

Kuptimi i ekuacionit të konvertim it është siç vijon

$$C_e = \frac{(21 - O_{2e})}{(21 - O_2)} \times C$$

Ve
Vn

Ve+Vn= vëllimi total i gazit (m3N)
Ve : vëllimi i gazit në O_{2e} (m3N)
Vn: Ajri (m3N) O2=21%

- sasi e pluhurit është e njëjtë
  C × (Ve+Vn)=Ce × Ve
- bilanci O2
  Ve × O_{2e} /100+Vn × 21/100 = (Ve+Vn) × O_2 ⟶ $V_n = \frac{(O_2 - O_{2e})}{(21 - O_2)} \times V_e$

$$C_e = \frac{V_e + V_n}{V_e} \times C = \left[1 + \frac{(O_2 - O_{2e})}{(21 - O_2)}\right] \times C = \frac{(21 - O_{2e})}{(21 - O_2)} \times C$$

37 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Përmbledhje -

Për të llogaritur shpejtësinë e rrjedhës së gazit të shkarkuar, kërkohen elementet në vijim
(2) Përbërja e gazit të shkarkuar
(3) Përbërja e lëngshme e gazit të shkarkuar
(4) Temperatura e gazit të shkarkuar
(5) Presioni statik i gazit të shkarkuar
(6) Presioni dinamik i gazit të shkarkuar.
↓
Dhe më pastaj, duhet të llogaritet dendësia e gazit të shkarkuar, dhe në fund shpejtësia e gazit mund të llogaritet duke përdorur dendësinë e gazit të shkarkuar.

38 独立行政法人 国際協力機構

Matja në Terren e Gazit në Masë
- Matja e pluhurit -

- Referencë -

- Metoda e matjes së gazit të shkarkuar për koncentrim të blozës dhe pluhurit -

Pajisja për mbledhjen e mostrës së pluhurit ndahet në 2 lloje:
pajisja manuale për mbledhjen e mostrës së pluhurit dhe pajisja automatike për mbledhjen e mostrës së pluhurit.

○ Pajisja manuale për mbledhjen e mostrës së pluhurit: Shpejtësia e rrjedhës së gazit llogaritet në mënyrë manuale dhe vëllimi i rrjedhës i marrë mostër përshtatet në mënyrë manuale.
Kjo korrespondon me pajisjen që është shpjeguar në kurs.

○ Pajisja automatike për mbledhjen e mostrës së pluhurit: Shpejtësia e rrjedhës së gazit llogaritet
në mënyrë automatike përmes një aparati dhe vëllimi i rrjedhës i marrë mostër përshtatet
në mënyrë automatike përmes një aparati sipas shpejtësisë së ndryshueshme aktuale të rrjedhës.

39 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

40 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

- Pika e Matjes -

Rrjedha e njëtrajtshme lejon, nëse konfirmohet njëtrajtshmëria.
- Për të zvogëluar pikat e matjes
- Për të marrë mostrën e përmbajtjes së gazit dhe ujit, dhe temperaturës nga çdo vend në gyp

Siguria dhe pajisjet janë shumë të rëndësishme
- Shkallët (kujdesi ndaj vjetërsisë)
- parmakët (kujdesi ndaj vjetërsisë)
- furnizimi me rrymë elektrike
-ndriçimi, etj.

41 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

- Prova e pluhurit -

Askush nuk e din se sa pluhur ka në gazit të shkarkuar.
-**Prova e pluhurit** është një mënyrë për të konfirmuar vëllimin e thithjes.
Vëllimi i thithjes duhet të përcaktohet përmes koncentrimit të blozës dhe pluhurit në gazin të shkarkuar.
Vëllimi i thithjes (m3/min)
= **Zona e kryqëzimit seksional të grykës** (m2) x Shpejtësia e rrjedhës (m/min) x **Koha e marrjes së mostrës**

○ Sasi e lartë e blozës dhe pluhurit: Vëllim i ulët i thithjes
Grykë e vogël dhe kohë e shkurtër e marrjes së mostrës
○ Sasi e ulët e blozës dhe pluhurit: Vëllim i lartë i thithjes
Grykë e madhe dhe kohë e gjatë e marrjes së mostrës

42 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

Operimi i Kazanit Gjatë Matjes së Gazit

- Ngarkesa e Kazanit duhet të jetë Stabile
- Qymyri duhet të jetë i Cilësisë së Njëjtë
- Rrjedha e Ajrit duhet të jetë Konstante
- Fryrja e Blozës duhet të Ndalet

↓

Duhet të Kontrollohet para Fillimit dhe Gjatë Matjes në terren të Gazit në masë

43 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

- Përmbajtja e Sulfurit në Qymyr ndikon në Koncentrimin e SOx
- Përmbajtja e Azotit në Qymyr ndikon në Gjenerimin e NOx
- Përmbajtja e Hirit në Qymyr dhe Karboni i Padjegur ndikon në Ngarkesën e Pluhurit
- Ajri i tepërt (O2 në gazin e gypit të oxhakut) ka ndikim në
  - Karbonin e Padjegur, Gjenerimin e CO
  - Gjenerimi i NOx
  - Rrjedha e Gazit nga Gypi i Oxhakut → Efikasiteti ESP

44 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

Së paku këto të Dhëna të Operimit të Kazanit duhet të Regjistrohen dhe t'i Bashkëngjiten rezultateve të matjes në terren të gazit në masë

1.Ngarkesa e Kazanit (Rrjedha e Avullit)
2.Presioni dhe Temperatura e Avullit
3.Rrjedha e Qymyrit
4.Rrjedha e Ajrit (O2; nëse njehsori i O2 është në dispozicion)
5.Temperatura e Ajrit të Mjedisit dhe Lagështia
6.Ventilatori FD për dalje të Ajrit dhe Ventilatori ID për hyrje të Presionit të Gazit

45 独立行政法人 国際協力機構

Vëmendja në matjet në terren të gazit në masë

Analizat e **Qymyrit, hirit fundërrinë, dhe hirit në ajër** janë të planifikuara për të ndihmuar analizën e gjendjes së kazanit.

- Analiza e Qymyrit
  - Analiza e Përafërt
    Lagështia, Materia e paqëndrueshme, Karboni i fiksuar, Hiri, Sulfuri
  - Analizat Përfundimtare
    Karboni, Hidrogjeni, Azoti, Oksigjeni, Sulfuri, Hiri
  - Vlerë më e Lartë e Ngrohjes

46 独立行政法人 国際協力機構

Faleminderit për bashkëpunimin tuaj

47 独立行政法人 国際協力機構

２－３　第 1 次派遣：中間報告会

２－３－１　概要

<table>
<tr><td>実施場所</td><td colspan="3">MESP</td></tr>
<tr><td>日　時</td><td>2015 年 11 月 2 日（月）9：00~10：30</td><td>場　所</td><td>MESP 会議室（Conference room）</td></tr>
<tr><td rowspan="2">出 席 者</td><td>先方</td><td colspan="2">Ms. Hakaj Nezakete、Mr. Abdlillah Pirce、Ms. Letafete Latifi、Mr. Mentor Shala、Mr. Shkumbin Shala、Mr. Xhemajl Sejdiu、Ms.Qefsere Muraky、Ms.Visare Hoxna Istefi、Mr.Agim Morina、Mr. Sabri Simnica(#A)、Mr. Xhemajl Sejdiu、Mr. Milaim Kelmendi(#B)、Mr.Zeqirtahta Htseni(#B)、Mr.Salsit Resfelicu(KEPA)</td></tr>
<tr><td>調査団側</td><td colspan="2">清水、臼井、中嶋、（通訳：Mr. Nehat、Mr. Kastriot）</td></tr>
<tr><td>配布資料</td><td colspan="3">Exhaust Gas Measurement (Dust measurement) Interim Report
Schedule of Kosovo B Measurement</td></tr>
<tr><td>収集資料</td><td colspan="3">なし</td></tr>
<tr><td>筆記者</td><td colspan="3">清水</td></tr>
</table>

（目的）

3. 今週実施する Kosovo B TPP の測定スケジュールについて説明を実施し、周知した。また同時に石炭等のサンプリングについての了解を得た。
4. 前の週に実施した Kosovo A TPP のダスト測定結果について報告した。
5. ダストの測定方法について写真を使いながら再度説明を実施した。

（結果）

上記 1,3 の項目については特に質問はなかった。ただし、項目 2（ダスト測定結果）については C/P 関係者内の議論が結構行われた。以下に C/P から調査団側へなされた質問および調査団側からのコメントと、議論の内容（確実には把握できていないが）を示す。

2. 質問およびコメント

- ダストの規制値はいくらか
  EU Directive によれば、ダスト濃度の規制値は LCP に対し 40mg/m3N（日本は 50mg/m3N）、将来的には 20mg/m3N になる。
- 現状の排出量は大幅に超えているということか？
  大幅に超えているという回答となる。
  コメント：EU Directive の規制値の内容を認識している人はほとんどいないと思われる。また、ダストの数値は O2=6%換算値を示したが、この換算をする必要性およびその意味が分かっている人もほとんどいないという印象を受けた。
- 今回の測定では時間的制約もあり、すべてのポイントにおけるダストを測定したわけではない。特に今回はダクトの曲がっている部分での測定であるため、ダストに分布がある可能性もある。正確な測定をするならば全部の場所を測定する必要がある。そのためには自分たちで測定できるようになり、かつ何度も測定を実施する必要がある。

- プレゼン内で、今回 SO2 については検知管で 0~120ppm しか出ず、これはおかしいというコメントをしたところ、Kosovo B からはそれは正しいといったコメントがなされた。
  コメント：調査団側としては、石炭の性状から考えて SO2 はかなり高いと推定（コンタクトミッションが入手した石炭性状分析結果から推算すると、燃焼性硫黄のみが SO x に転換するとしても数百 ppm を超える）しているが、第 2 次派遣時に連続分析計を持ち込むことで、正しい値を得られるものと考えている。

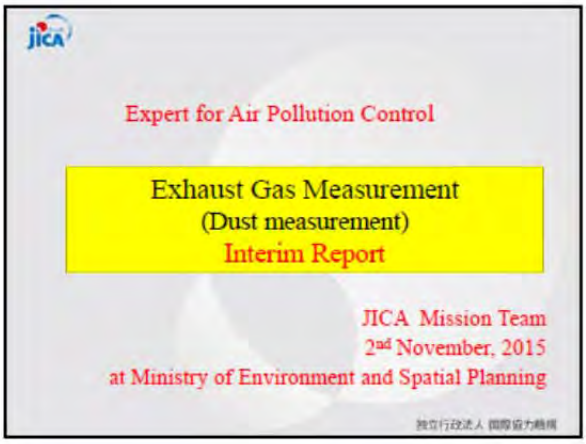
3. 議論の内容

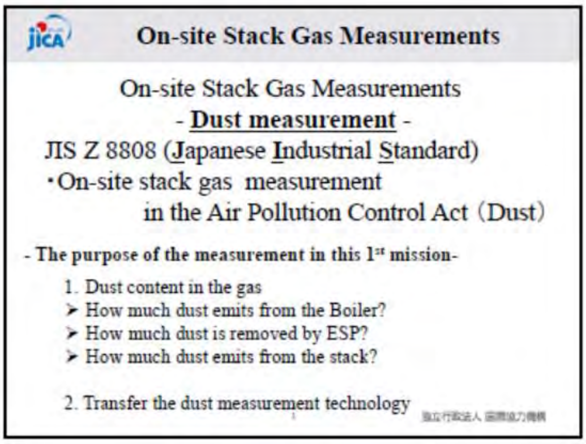
ダスト測定結果が高かったことから、なぜ高いのかといった議論がなされ、Kosovo A の責任者である Sabri 氏より各種説明がなされた（石炭の性状が不燃物の量が多い石炭だった可能性もある等）。Kosovo B からは ESP 入側のダスト濃度が異常に高く、計算値では 40g/m3 位のはずだが、200g/m3 近い値を示しているのはおかしいといった発言があったり、ESP 電極のハンマリングのためにダスト濃度が上がったのではないかといったいろいろなコメントが続出した。これに対し Sabri 氏より ESP 入側で測定するのは初めてであるし、出側についても操業開始のころに測定して以来測定したことはなく、またいろいろな操業状態があるということから、自分たちで測定できるようになって、頻繁に測定することが必要であるといったコメントもなされた(ダスト濃度を ESP 入側で測定した経験はないよう（すくなくとも Kosovo B には測定座がなかった）であり、かつ特に Kosovo B の関係者は計算値で十分であり、測定値はおかしいのではないかといった考えを持っている人も多いとの印象を受けた)。

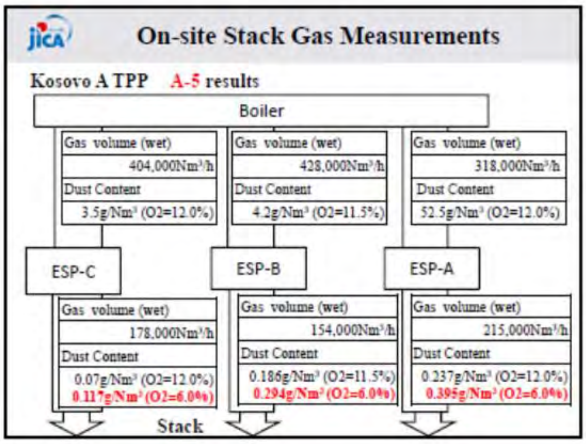
また、規制値よりダスト濃度が高いことに対し、どうするのかといった議論もなされたが、この場での議論ではないということで打ち切られた。

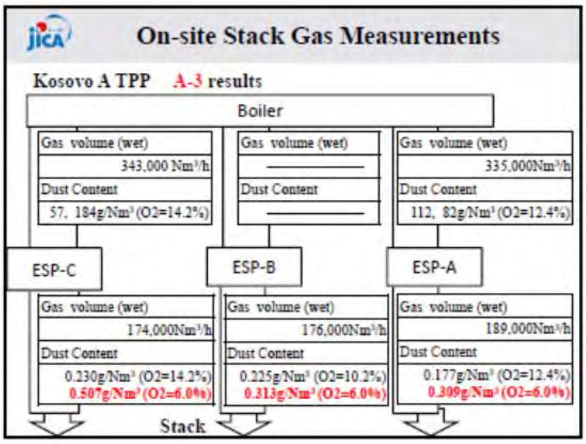
最後に Sabri 氏より、測定結果をもらった（生データを渡した）ことに対する感謝があり、調査団側から Sabri 氏の測定への協力の感謝の意を示した。

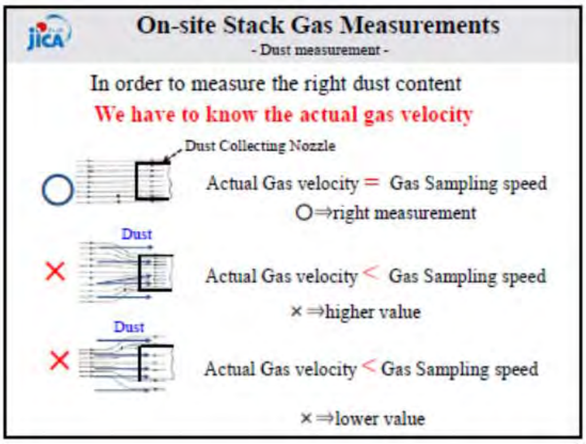
以上

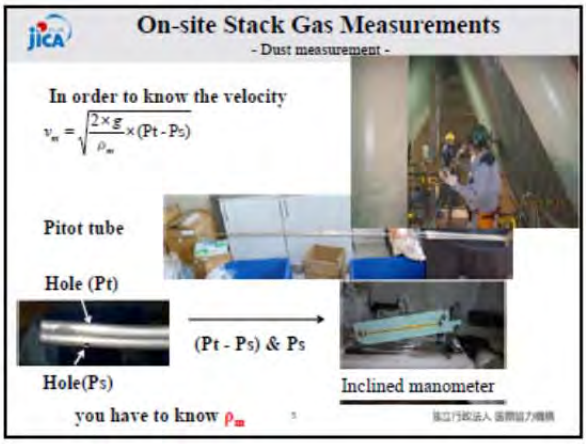

Expert for Air Pollution Control
Exhaust Gas Measurement
(Dust measurement)
Interim Report
JICA Mission Team
2nd November, 2015
at Ministry of Environment and Spatial Planning

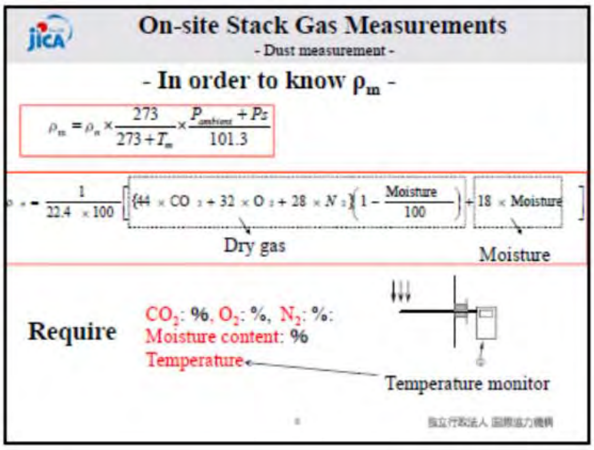

On-site Stack Gas Measurements
On-site Stack Gas Measurements
- Dust measurement -
JIS Z 8808 (Japanese Industrial Standard)
・On-site stack gas measurement
in the Air Pollution Control Act (Dust)
- The purpose of the measurement in this 1st mission-
1. Dust content in the gas
➢ How much dust emits from the Boiler?
➢ How much dust is removed by ESP?
➢ How much dust emits from the stack?
2. Transfer the dust measurement technology


On-site Stack Gas Measurements
Kosovo A TPP A-5 results
Boiler
Gas volume (wet) 404,000Nm³/h
Dust Content 3.5g/Nm³ (O2=12.0%)
Gas volume (wet) 428,000Nm³/h
Dust Content 4.2g/Nm³ (O2=11.5%)
Gas volume (wet) 318,000Nm³/h
Dust Content 52.5g/Nm³ (O2=12.0%)
ESP-C
ESP-B
ESP-A
Gas volume (wet) 178,000Nm³/h
Dust Content 0.07g/Nm³ (O2=12.0%) 0.117g/Nm³ (O2=6.0%)
Gas volume (wet) 154,000Nm³/h
Dust Content 0.186g/Nm³ (O2=11.5%) 0.294g/Nm³ (O2=6.0%)
Gas volume (wet) 215,000Nm³/h
Dust Content 0.237g/Nm³ (O2=12.0%) 0.395g/Nm³ (O2=6.0%)
Stack

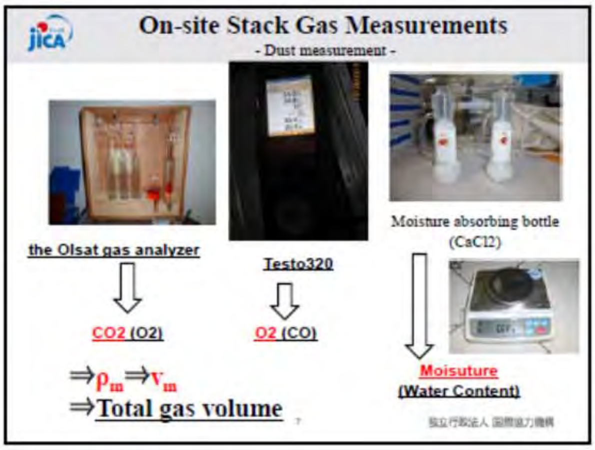

On-site Stack Gas Measurements
Kosovo A TPP A-3 results
Boiler
Gas volume (wet) 343,000 Nm³/h
Dust Content 57. 184g/Nm³ (O2=14.2%)
Gas volume (wet)
Dust Content
Gas volume (wet) 335,000Nm³/h
Dust Content 112. 82g/Nm³ (O2=12.4%)
ESP-C
ESP-B
ESP-A
Gas volume (wet) 174,000Nm³/h
Dust Content 0.230g/Nm³ (O2=14.2%) 0.507g/Nm³ (O2=6.0%)
Gas volume (wet) 176,000Nm³/h
Dust Content 0.225g/Nm³ (O2=10.2%) 0.313g/Nm³ (O2=6.0%)
Gas volume (wet) 189,000Nm³/h
Dust Content 0.177g/Nm³ (O2=12.4%) 0.309g/Nm³ (O2=6.0%)
Stack


On-site Stack Gas Measurements
- Dust measurement -
In order to measure the right dust content
We have to know the actual gas velocity
Dust Collecting Nozzle
Actual Gas velocity = Gas Sampling speed
○⇒right measurement
Dust
Actual Gas velocity < Gas Sampling speed
×⇒higher value
Dust
Actual Gas velocity < Gas Sampling speed
×⇒lower value

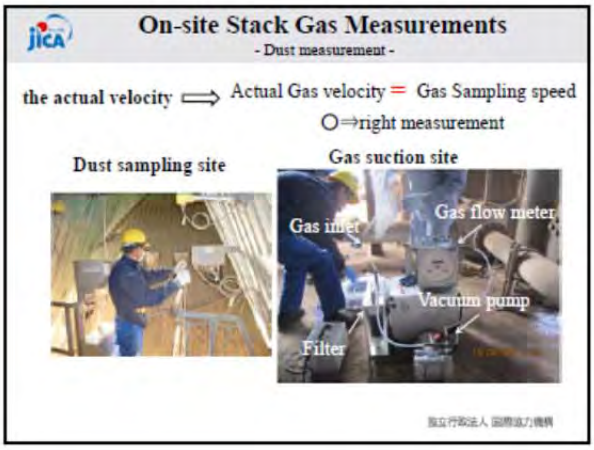

On-site Stack Gas Measurements
- Dust measurement -
In order to know the velocity
$v_m = \sqrt{\frac{2 \times g}{\rho_m}} \times (Pt - Ps)$
Pitot tube
Hole (Pt)
Hole(Ps)
(Pt - Ps) & Ps
Inclined manometer
you have to know ρ_m



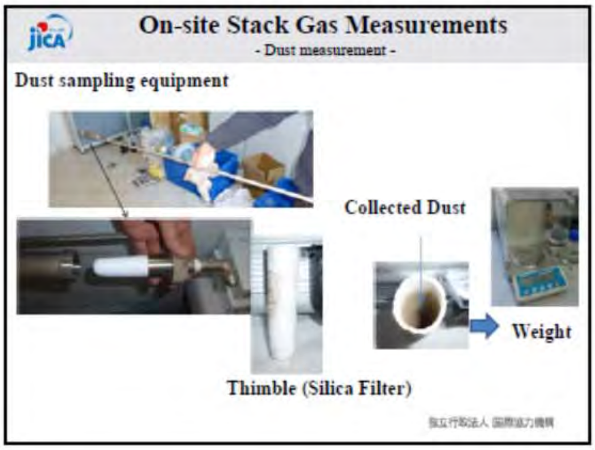
On-site Stack Gas Measurements
- Dust measurement -
- In order to know ρ_m -
$\rho_m = \rho_n \times \frac{273}{273+T_m} \times \frac{P_{ambient}+Ps}{101.3}$
Dry gas
Moisture
Require
CO_2: %, O_2: %, N_2: %:
Moisture content: %
Temperature
Temperature monitor



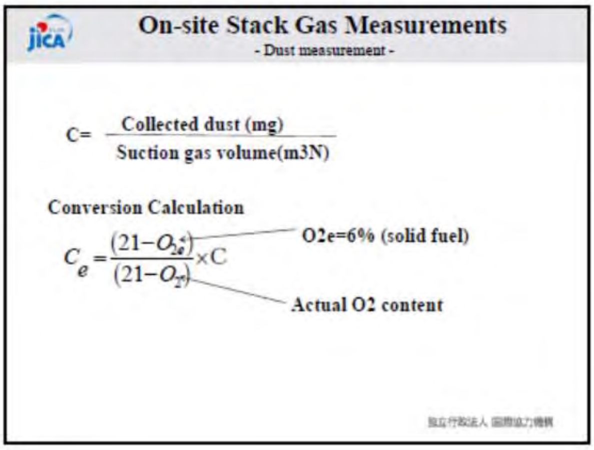
On-site Stack Gas Measurements
- Dust measurement -
the Olsat gas analyzer
Testo320
Moisture absorbing bottle (CaCl2)
CO2 (O2)
O2 (CO)
Moisuture (Water Content)
$\Rightarrow \rho_m \Rightarrow v_m$
$\Rightarrow$ Total gas volume



On-site Stack Gas Measurements
- Dust measurement -
the actual velocity
Actual Gas velocity = Gas Sampling speed
O⇒right measurement
Dust sampling site
Gas suction site
Gas inlet
Gas flow meter
Vacuum pump
Filter

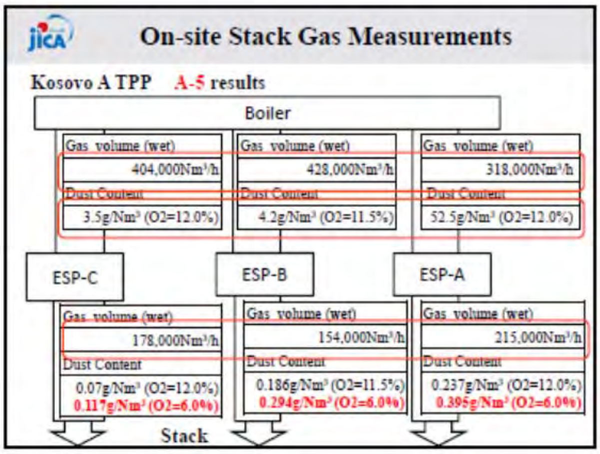


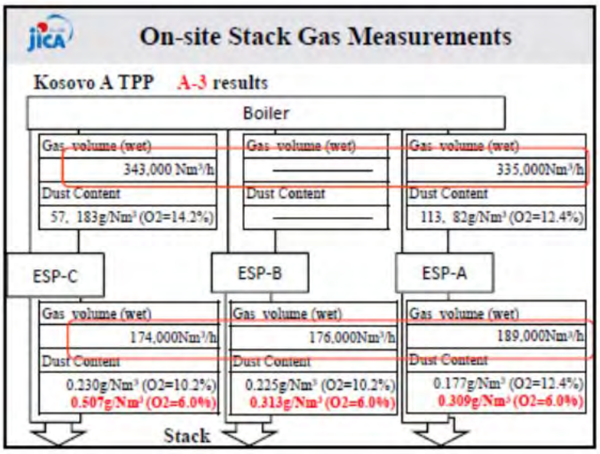
On-site Stack Gas Measurements
- Dust measurement -
Dust sampling equipment
Collected Dust
Weight
Thimble (Silica Filter)

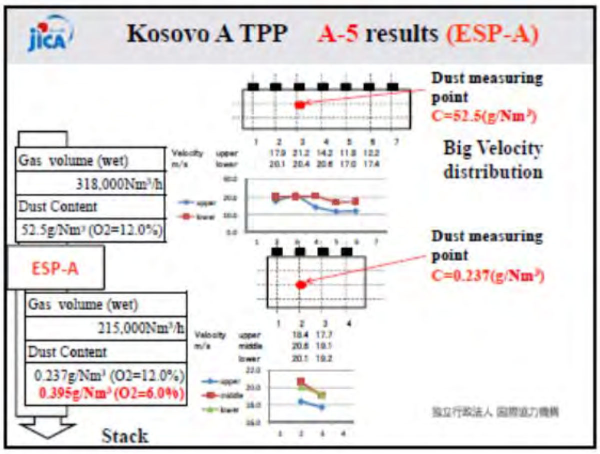


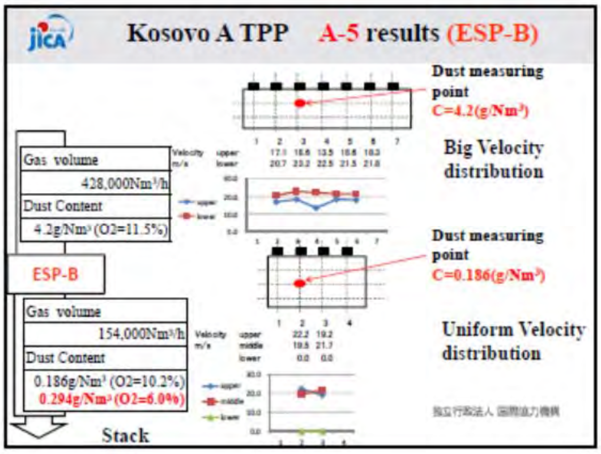
On-site Stack Gas Measurements
- Dust measurement -
C= Collected dust (mg) / Suction gas volume(m3N)
Conversion Calculation
$C_e = \frac{(21-O_{2e})}{(21-O_2)} \times C$
O2e=6% (solid fuel)
Actual O2 content

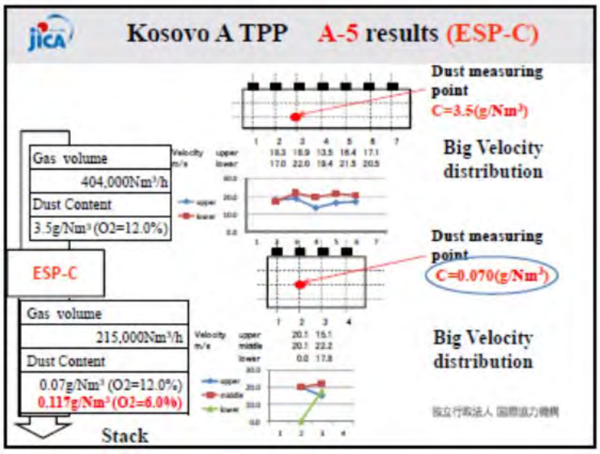
Collecting the boiler information
Safety measures
Safety belt
Safety chain

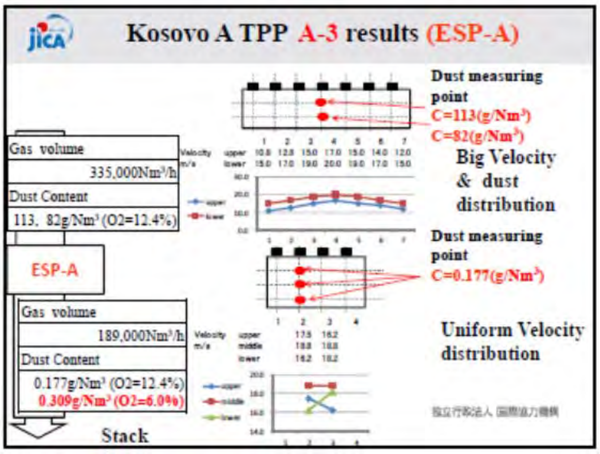

On-site Stack Gas Measurements
Kosovo A TPP A-5 results
Boiler
Gas volume (wet)
404,000Nm³/h
Dust Content
3.5g/Nm³ (O2=12.0%)
Gas volume (wet)
428,000Nm³/h
Dust Content
4.2g/Nm³ (O2=11.5%)
Gas volume (wet)
318,000Nm³/h
Dust Content
52.5g/Nm³ (O2=12.0%)
ESP-C
ESP-B
ESP-A
Gas volume (wet)
178,000Nm³/h
Dust Content
0.07g/Nm³ (O2=12.0%)
0.117g/Nm³ (O2=6.0%)
Gas volume (wet)
154,000Nm³/h
Dust Content
0.186g/Nm³ (O2=11.5%)
0.294g/Nm³ (O2=6.0%)
Gas volume (wet)
215,000Nm³/h
Dust Content
0.237g/Nm³ (O2=12.0%)
0.395g/Nm³ (O2=6.0%)
Stack

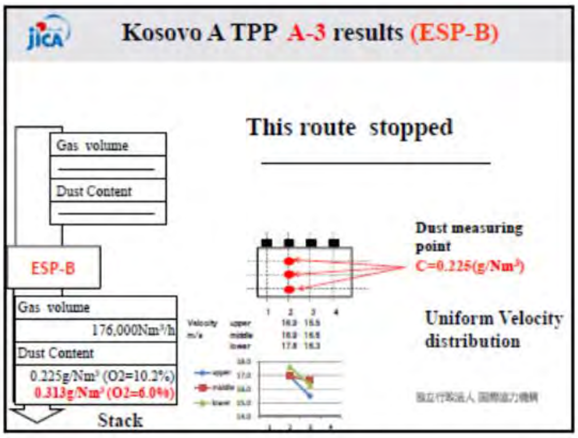

On-site Stack Gas Measurements
Kosovo A TPP A-3 results
Boiler
Gas volume (wet)
343,000 Nm³/h
Dust Content
57, 183g/Nm³ (O2=14.2%)
Gas volume (wet)
Dust Content
Gas volume (wet)
335,000Nm³/h
Dust Content
113, 82g/Nm³ (O2=12.4%)
ESP-C
ESP-B
ESP-A
Gas volume (wet)
174,000Nm³/h
Dust Content
0.230g/Nm³ (O2=10.2%)
0.507g/Nm³ (O2=6.0%)
Gas volume (wet)
176,000Nm³/h
Dust Content
0.225g/Nm³ (O2=10.2%)
0.313g/Nm³ (O2=6.0%)
Gas volume (wet)
189,000Nm³/h
Dust Content
0.177g/Nm³ (O2=12.4%)
0.309g/Nm³ (O2=6.0%)
Stack

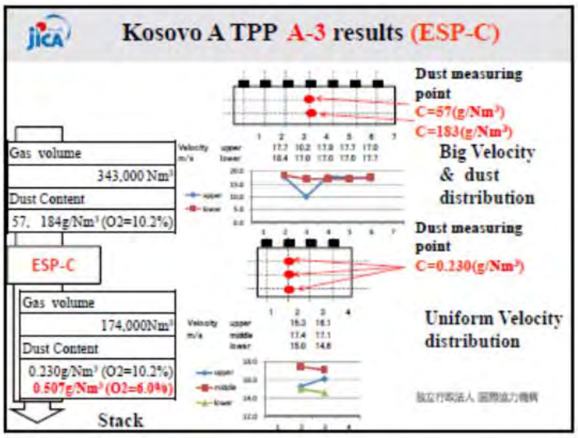

Kosovo A TPP A-5 results (ESP-A)
Dust measuring point
C=52.5(g/Nm³)
Big Velocity distribution
Gas volume (wet)
318,000Nm³/h
Dust Content
52.5g/Nm³ (O2=12.0%)
ESP-A
Dust measuring point
C=0.237(g/Nm³)
Gas volume (wet)
215,000Nm³/h
Dust Content
0.237g/Nm³ (O2=12.0%)
0.395g/Nm³ (O2=6.0%)
Stack


Kosovo A TPP A-5 results (ESP-B)
Dust measuring point
C=4.2(g/Nm³)
Big Velocity distribution
Gas volume
428,000Nm³/h
Dust Content
4.2g/Nm³ (O2=11.5%)
ESP-B
Dust measuring point
C=0.186(g/Nm³)
Uniform Velocity distribution
Gas volume
154,000Nm³/h
Dust Content
0.186g/Nm³ (O2=10.2%)
0.294g/Nm³ (O2=6.0%)
Stack


Kosovo A TPP A-5 results (ESP-C)
Dust measuring point
C=3.5(g/Nm³)
Big Velocity distribution
Gas volume
404,000Nm³/h
Dust Content
3.5g/Nm³ (O2=12.0%)
ESP-C
Dust measuring point
C=0.070(g/Nm³)
Big Velocity distribution
Gas volume
215,000Nm³/h
Dust Content
0.07g/Nm³ (O2=12.0%)
0.117g/Nm³ (O2=6.0%)
Stack


Kosovo A TPP A-3 results (ESP-A)
Dust measuring point
C=113(g/Nm³)
C=82(g/Nm³)
Big Velocity & dust distribution
Gas volume
335,000Nm³/h
Dust Content
113, 82g/Nm³ (O2=12.4%)
ESP-A
Dust measuring point
C=0.177(g/Nm³)
Uniform Velocity distribution
Gas volume
189,000Nm³/h
Dust Content
0.177g/Nm³ (O2=12.4%)
0.309g/Nm³ (O2=6.0%)
Stack





On-site Stack Gas Measurements

- Dust measurement -

1. Big difference in the gas volume between inlet and outlet
   - Expected gas volume from coal combustion
     ~ 600, 000 m3N/h
     (expected from Coal Combustion and O2 content)
   - Inlet gas volume (measured value)
     ~
   - Outlet gas volume (measured value)
     ~
     ?????????
2. Big difference in the dust content along to the depth
   ?????????

On-site Stack Gas Measurements

- Dust measurement -

Other comments

1. SOx, NOx analysis with detective tube
   NOx: 300 ~ 400 ppm This is reasonable
   SOx: 0 ~ 120 ppm ?????
   ⇒SOx detection is not successful !
2. O2 content
   O2 meter at the control room 6~7%
   O2 meter by Testo 10~13%
   ⇒Big difference!

Thank you for your cooperation

２－４　第１次派遣：第２回ワークショップ

２－４－１　概要

会議名	第 2 回ワークショップ		
実施場所	MESP		
日　時	2015 年 11 月 10 日(火)　13:00～16:00	場　所	MESP コンファレンスルーム
出 席 者	先方	C/P 関係者及び KEK(ボイラ運営会社)エンジニア一同	
	調査団側	清水、臼井、中嶋（通訳：Mr. Nehat、Mr. Kastriot）	
配布資料	Exhaust Gas Measurement　(Dust measurement) Report “Air Pollution and Boiler”　(ワークショップ資料)		
収集資料	アンケート		
筆記者	清水、中嶋		

（目的）

第 2 回ワークショップとしてボイラ関係の資料を説明した。また、同時に排ガス測定結果として Kosovo B-1 TPP のダスト測定結果について報告した。

（結果）

最初に測定結果について質問が集中したので、測定結果についての説明を実施した。

質問及びコメントは以下のようなものであった。

最終的にはデータに関する疑問点を整理し、後でメールしてもらい、第 2 次ミッションで回答を用意することとなった。

1. Kosovo A-5、A-3 の測定結果に関して、途中で修正があったが測定の問題があったのか？
   - この点に関しては私がデータをコピーするときに間違えたためであり、謝罪する。
2. Kosovo A のデータについてはいろいろと議論があるようだが、その点はどう考えているか？
   - Kosovo A（Mr.Sabri）より：その点については調査団とはよく議論した。問題点はガス量が計算とかなりかけ離れていること、ESP 入側のダスト量が多すぎること、出側のダスト量が高すぎるのではないかといった点である。
   - 調査団側としては、第 2 次ミッションでそのような点を考慮して再度測定を実施するとともに、そのような矛盾を生じた原因を考慮する。
3. Kosovo B の結果について
   - Kosovo B の結果については測定ガス量が少ないと考えられることを除けば、ダスト量は妥当である。（調査団としては一つの測定結果のダスト濃度が 450mg/m^3N もあったことに全く言及がなかったことが不思議であった）

ボイラについての説明

最初に測定結果について質問が集中したことで、説明の時間が少なくなり、最終的にはプレゼンに関する質問を後でメールしてもらい、第 2 次ミッションで回答を用意することとなった。

- 石炭の分類について説明し、ボイラは石炭の性状に合わせて設計する。Lignite は揮発分が多く、水分、灰分が多いのが一般的で、石炭を乾燥させて粉砕して燃焼する Combustion System が、Lignite と比べ品質の良い瀝青炭や亜瀝青炭を輸入して使用している日本のボイラの System とは異なる。火炉の Size は Lignite が火炉出口のガス温度を下げる必要から大きくなり、Kosovo-B のボイラの高さと日本の 1000MW のボイラと高さにあまり差はない。日本のほとんどのボイラは、NOx、SO_X、DUST の排出低減のため、脱硝装置（SCR）、脱硫装置（FGD）、ESP を設置している。
- 排ガス測定をする時には、燃料の分析値や、燃料消費量から、燃焼計算により燃焼ガス量、SOx の計算を行い測定結果と比較して、大きな差がないか確認をする。差がある時には測定結果が、排ガス性状を代表していない事があり、測定点や、Duct 内のガス流れに問題がある可能性があり、その原因について検討が必要である。

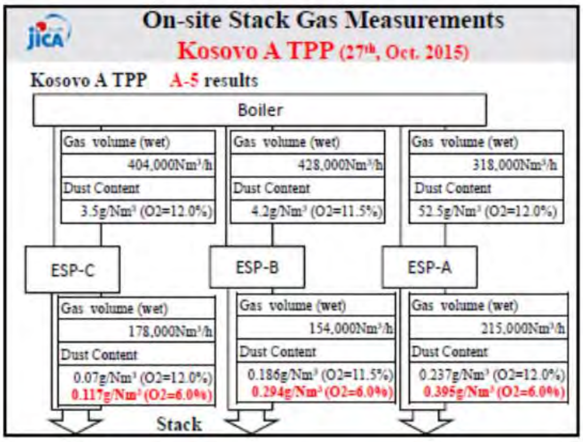
  適正な状態で測定すればガス量は計算値とかけ離れる事はないが、SO_X は、燃焼温度によって、全ての S 分が SO_2 になるのではなく、燃焼温度が低い場合には燃焼性 S 分しか SO_X に転換しない事もある。また、石炭中に Ca を多く含んでいると、炉内で脱硫反応（CaO と SO_2 が反応して CaSO4 となる）が一部起こることもある。NO_X の生成は燃焼方法（2 段燃焼、低 NOX バーナ）などで変化するので、計算では予測できない。DUST 濃度は石炭中の Ash と、炉底に落ちる Bottom Ash と燃焼ガスで運ばれる Fly Ash の関係から、おおよその推定ができる。（Mr. Sabri は理解しているが、他の C/P は理解しているか疑問である）

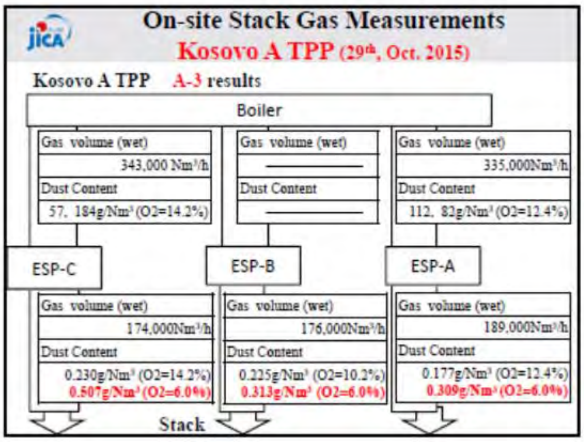
  ボイラを効率良く運転する事は、排出ガス量の削減、ガス性状の改善に有効で、日常の運転／保守が重要である。

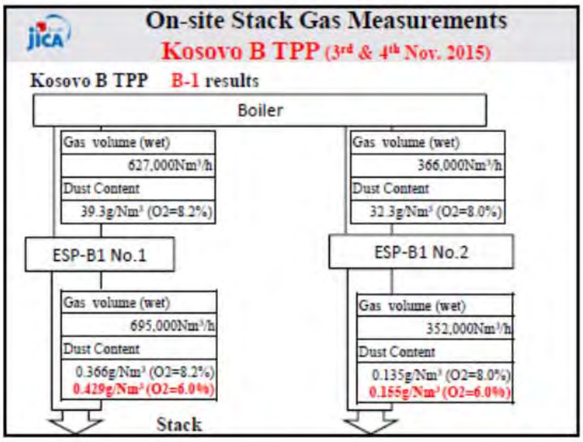
- 以上 -

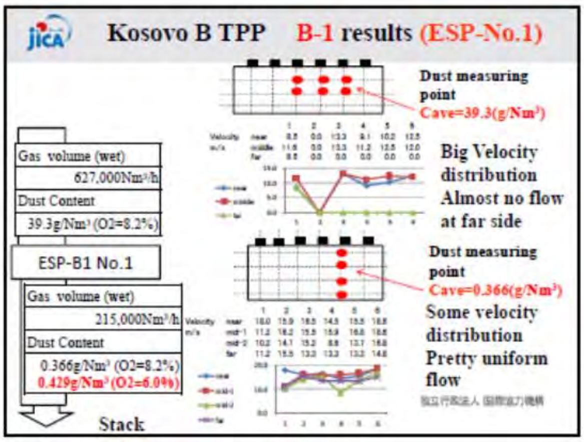
２－４－２　ワークショップ資料（英語版）

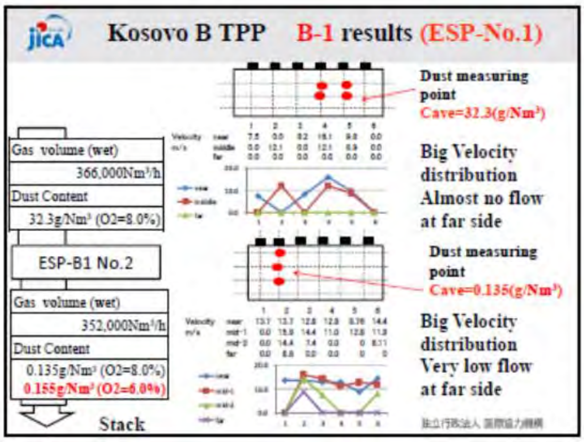
(1)Kosovo B TPP 測定結果











On-site Stack Gas Measurements
- Kosovo B-1 -

Dust measurement

1. Big difference in the gas volume between No.1ESP and No.2ESP
   ⇒No2 ESP has lower dust content because of lower gas volume.
2. Big velocity distribution of the inlet for both No.1ESP and No.2ESP
3. Big velocity distribution of the outlet for No.2ESP

Other comments

1. SOx, NOx analysis with detective tube
   NOx: ~500ppm This is reasonable
   (~600ppm at O2=6%)
   SOx: 0 ~ 120 ppm
   ⇒Same result as Kosovo A

It is always very important

- To evaluate the measured data with operation data
- To clarify how and what purpose to utilize these data

In order to achieve final purpose

Repeat the measurement, learn how to measure.

Thank you for your cooperation

(2)ボイラ用セミナ資料

Expert for Air Pollution Control
The Work Shop for

"Air Pollution and Boiler"

JICA Mission Team
10 Nov, 2015
at Ministry of Environment and Spatial Planning

独立行政法人 国際協力機構

Contents

1. Coal Firing Boiler
2. Generation of Pollution Material
3. Boiler Efficiency
4. Emission Measures

独立行政法人 国際協力機構

1. Coal Firing Boiler

独立行政法人 国際協力機構

1.1 Classification of Coal (1)

Degree of Carabonization

High ← Low

Coal Classification	Antracite	Bituminous Coal	Sub-Bituminous Coal	Brown Coal (lignite)
Heating Value (kcal/kg)*	>8400	8100～8400	7300～8100	5500～7300
Carbon Content (%)*	93～95	80～90	70～80	70

* Dry& AshFreeBasis

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1.2 Classification of Coal (2)

Degree of Carabonization

High ← Low

Coal Classification	Antracite	Bituminous Coal	Sub-Bituminous Coal	Brown Coal (lignite)
Fuel Ratio (Fixed Carbon/ Volatile Matter)	> 4	1.5 ～ 4	1 ～ 1.5	< 1
Moisture (%)*	< 10	< 15	15～30	30 ～ 60

* Dry Basis

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1.3 Coal Characteristic on Boiler Design

Item	Effect
FC/VM	Boiler Type, Burner
HHV	Boiler Size, Burner, Equipment Capacity
Moisture	Boiler Size, Burner, Pulverizer Capacity
Ash	Boiler Size, Burner, SH/RH/Eco (Erosion)
IDT of Ash	Boiler Size, Furnace Wall (Slagging)
Analysis	Boiler Size, SH/RH (Fauling)
S, Cl	Material, Metal Temp. (Corrosion)

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1.4 Effect on Power Plant Design

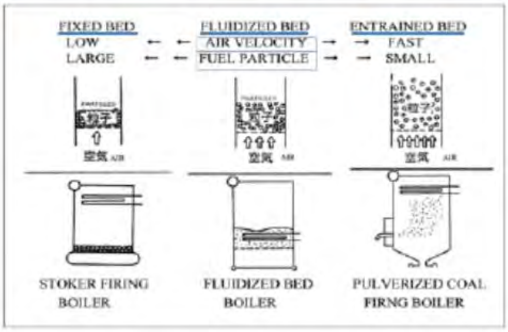
Quality of Coal	Hgh Ash Coal	High Moist. Coal
Transportaion	High Cost	High Cost
Storage	Wide Area	Wide Area
Boiler Efficiency	Low	Lower
Erossion	High	—
Slagging, Fauling	—	High
Ash Disposal	Difficult	—
Drying of Pulverized Coal	—	Special Measure
Boiler Size	Large	Large
Capacity of Aux. Equipment	Large	Large

1.5 Coal Characteristic on Boiler

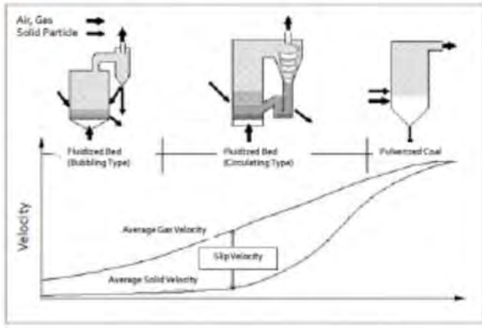
	Volatile Matter	Combustion	Slagging Fauling	Usage	Boiler Type
Lignite	High	Good (*1)	High(*2,*3)	Mine Mouth	Special, CFB
Sub-Bituminous			(*3)	Domestic	Noramal PC CFB
Bituminous				Export	
Semi-Anthracite				Domestic	U-Firing
Anthracite	Low	Poor	Low	Mine Mouth	

Note
*1: Poor if Moisture or Ash content is High
*2: Depend on the constitution of Ash
*3: High Potential of Spontaneous Combustion

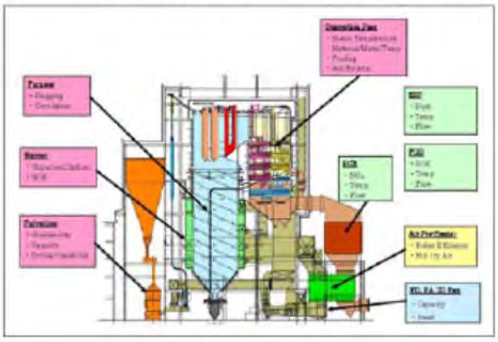
1.6 Boiler Type of Coal Combustion



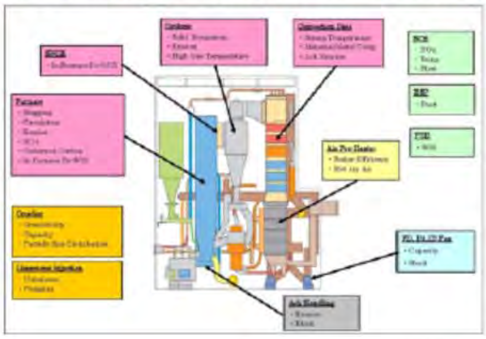
1.7 Gas/Solid Velocity in Furnace



1.8 Pulverized Coal Firing Boiler



1.9 Circulating Fluidized Bed Combustion Boiler (FBC)



1.10 Fluidized Bed Combustion Boiler (FBC)

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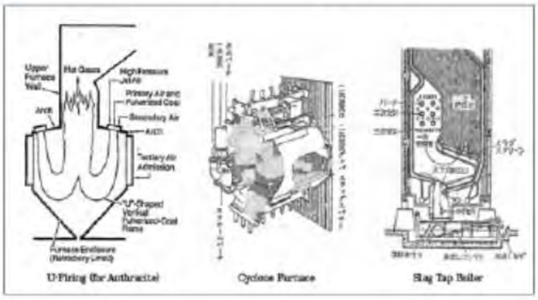
1.11 Special Type Boiler



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2. Generation of Pollution Material

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2.1 Generation of the air pollution material

1. SOx (SO_2, SO_3)

Generated by S in Coal

S + O2 =SO2, SO2 + O2 = 2SO3

(ratio of SO_3 in Coal Fired Boiler is few)

2. Dust (Ash + Unburned Carbon);

Generated by Ash and Carbon in Coal

- Generation of Unburened Carbon depends on the Combustion System of the Boiler and Excess Air Ration in Combustion
- Dust Concentration in Flue Gas is affected by the Dust Falling Distribution (Bottom, Economizer/AH Hopper, and to the ESP)

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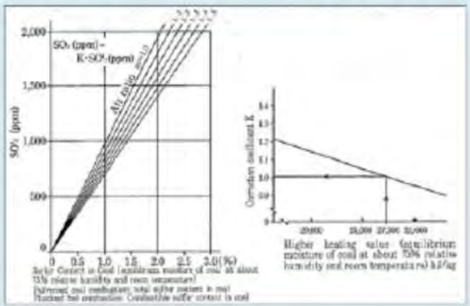
2.2 Relation between S content in Coal and SO2 Concentration in Dry Flue Gas



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2.3 Generation of the air pollution material

3. NOx (NO, NO_2)

Generated in Combustion Process by N in Coal and N_2 in Combustion Air

- Thermal NOx

  N2 +O = NO +O

  N + O2 = NO + O

  Zeldvich Mechanism

  $$NO = Ae^{-\frac{E}{RT}}[N_2][O_2]^{\frac{1}{2}}t_e$$

  A:Coeffient, E:Activate Energy
  R:Gas Constant, T: Flame Temp.
  Te: Retention Time in Temp.zone
  N2, O2: density(ppm)

- Fuel NOX

  Conversion Rate of N in Fuel to NO is Approx.15～30%

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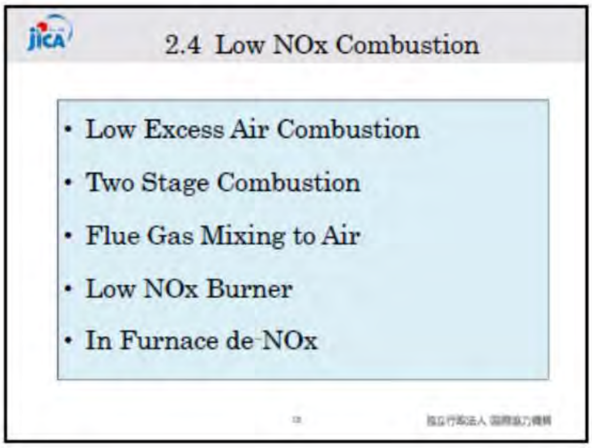
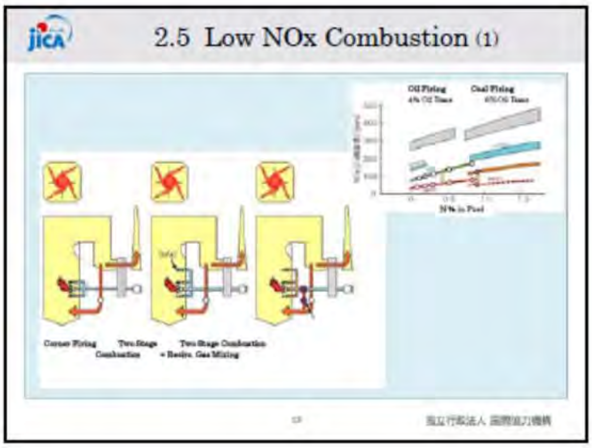
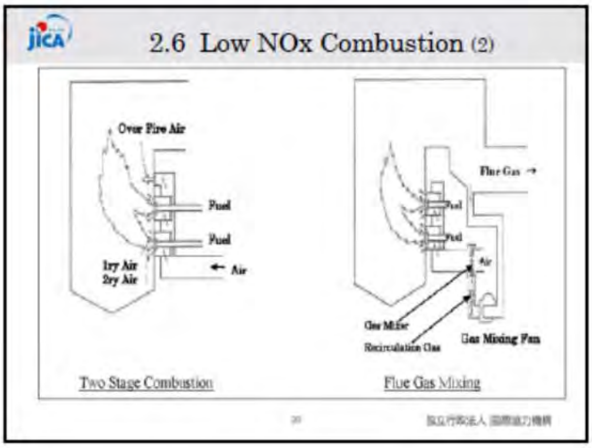
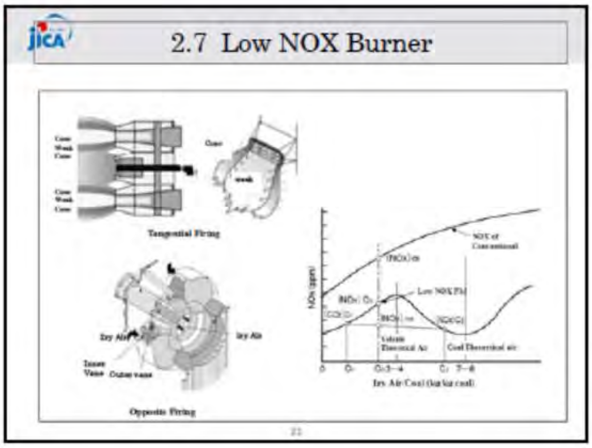
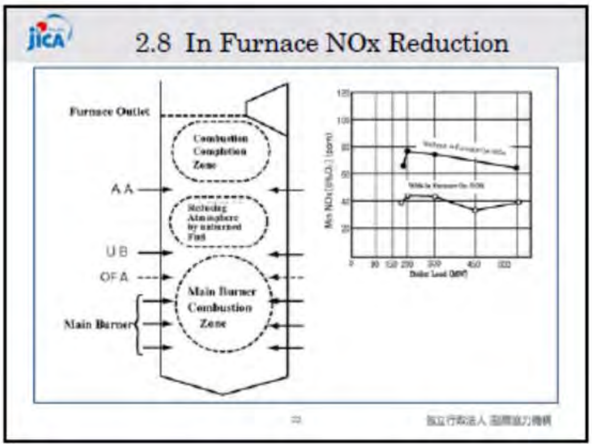
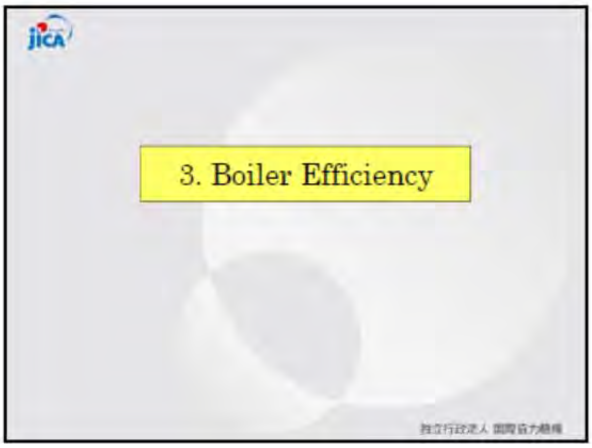

2.4 Low NOx Combustion
• Low Excess Air Combustion
• Two Stage Combustion
• Flue Gas Mixing to Air
• Low NOx Burner
• In Furnace de-NOx

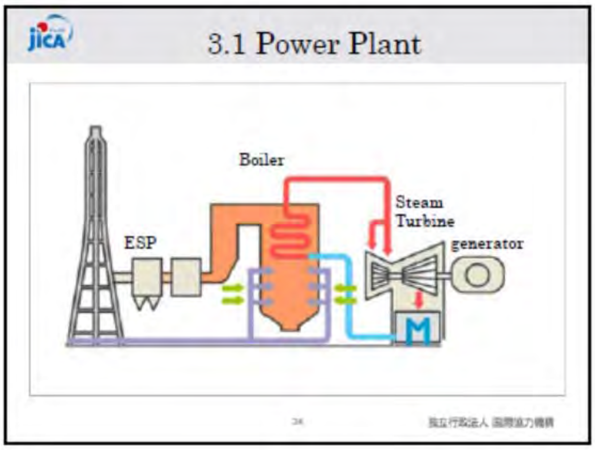

2.5 Low NOx Combustion (1)
Oil Firing
Coal Firing
N % in Fuel
Corner Firing
Two Stage Combustion
Two Stage Combustion + Recirc. Gas Mixing


2.6 Low NOx Combustion (2)
Over Fire Air
Fuel
Fuel
1ry Air
2ry Air
Air
Flue Gas
Gas Mixer
Recirculation Gas
Gas Mixing Fan
Two Stage Combustion
Flue Gas Mixing


2.7 Low NOX Burner
Tangential Firing
Opposite Firing
NOx (ppm)
Low NOX PM
1ry Air/Coal


2.8 In Furnace NOx Reduction
Furnace Outlet
Combustion Completion Zone
AA
UB
OFA
Main Burner
Main Burner Combustion Zone
Boiler Load (MW)


3. Boiler Efficiency


3.1 Power Plant
Boiler
Steam Turbine
ESP
generator
M
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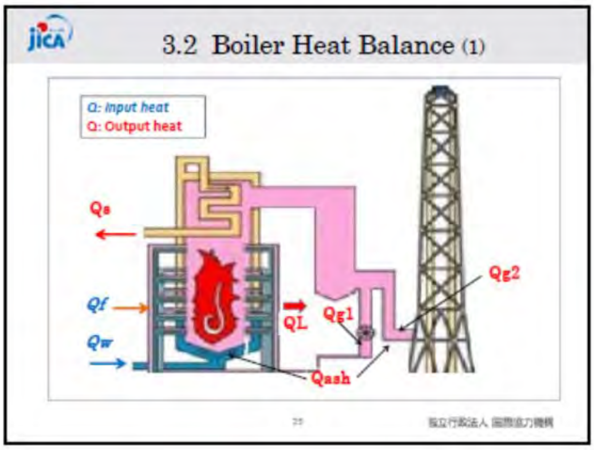
3.2 Boiler Heat Balance (1)
Q: Input heat
Q: Output heat
Qs
Qf
Qw
QL
Qg1
Qg2
Qash
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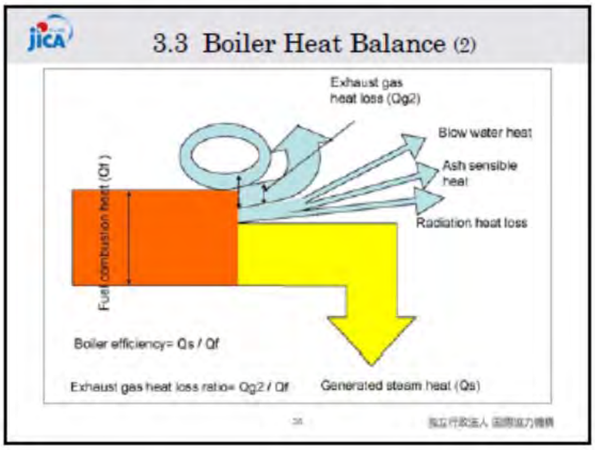
3.3 Boiler Heat Balance (2)
Exhaust gas heat loss (Qg2)
Blow water heat
Ash sensible heat
Radiation heat loss
Fuel combustion heat (Qf)
Boiler efficiency= Qs / Qf
Exhaust gas heat loss ratio= Qg2 / Qf
Generated steam heat (Qs)
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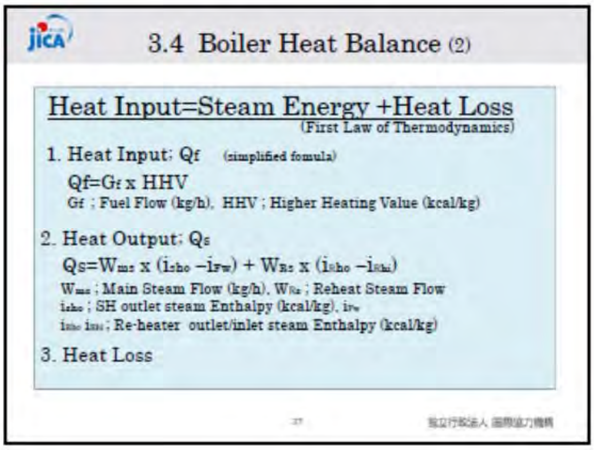
3.4 Boiler Heat Balance (2)
Heat Input=Steam Energy +Heat Loss
(First Law of Thermodynamics)
1. Heat Input; Qf (simplified fomula)
Qf=Gf x HHV
Gf ; Fuel Flow (kg/h), HHV ; Higher Heating Value (kcal/kg)
2. Heat Output; Qs
Qs=Wms x (isho −iFw) + WRs x (iRho −iRhi)
Wms ; Main Steam Flow (kg/h), WRs ; Reheat Steam Flow
isho ; SH outlet steam Enthalpy (kcal/kg), iFw
iRho iRhi ; Re-heater outlet/inlet steam Enthalpy (kcal/kg)
3. Heat Loss
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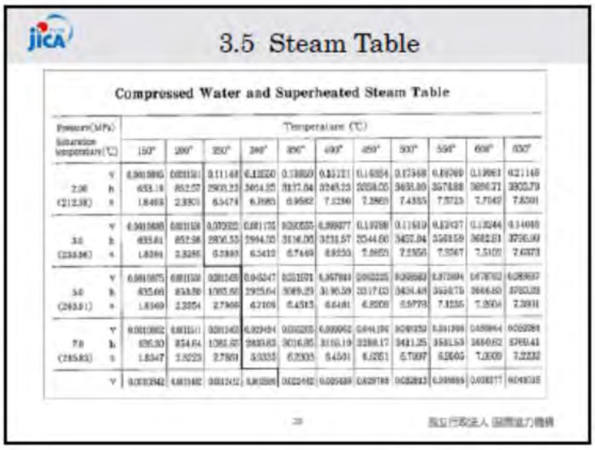
3.5 Steam Table
Compressed Water and Superheated Steam Table
Temperature (℃)
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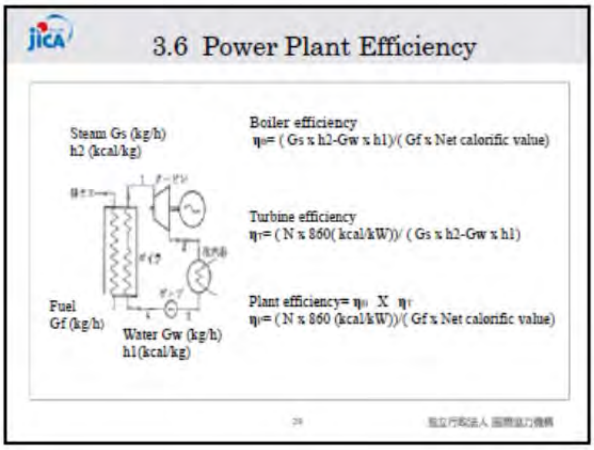
3.6 Power Plant Efficiency
Steam Gs (kg/h)
h2 (kcal/kg)
Fuel
Gf (kg/h)
Water Gw (kg/h)
h1(kcal/kg)
Boiler efficiency
ηB= (Gs x h2-Gw x h1)/(Gf x Net calorific value)
Turbine efficiency
ηT= (N x 860(kcal/kW))/ (Gs x h2-Gw x h1)
Plant efficiency= ηB X ηT
ηP= (N x 860 (kcal/kW))/(Gf x Net calorific value)
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3.7 Boiler Efficiency (Detail)

(Heat Input and Output Method)

$$\text{Boiler Efficiency} = \frac{\text{Heat Output}}{\text{Heat Input}} \times 100\ (\%)$$

(Heat Loss Method)

$$\text{Boiler Efficiency} = \left(1 - \frac{\text{Heat Loss}}{\text{Heat Input}}\right) \times 100\ (\%)$$

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3.8 Heat Input of Boiler (Detail)

Heat Input:

- Fuel Heat Input:

  Hf = Heat in fuel, higher heating value, kcal/kg

- Heat Credit:

  B = (Bae + Bze + Bfe + Bxe + Bma)/Wfe

  B : Total heat credits, kcal/kg

  Bae : Heat supplied by entering air, kcal

  Bze : Heat supplied by atomizing steam, kcal

  Bfe : Heat supplied by sensible heat in fuel, kcal

  Bxe : Heat supplied by auxiliary drives within the envelope, kcal

  Bma : Heat supplied by moisture in entering air, kcal

  Wfe : Measured fuel rate, kg

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3.8 Heat Loss of Boiler (Detail)

Heat Loss:

L = Luc + Lg + Lmf + Lh + Lma + Lz + Lb + Lum

L : Total heat loss from steam generator, kcal/kg

Luc : Heat loss due to unburned carbon in refuse, kcal/kg

Lg : Heat loss due to heat in dry flue gas, kcal/kg

Lmf : Heat loss due to moisture in the "as fired fuel", kcal/kg

Lh : Heat loss due to moisture from burning of hydrogen, kcal/kg

Lma : Heat loss due to moisture in the air, kcal/kg

Lz : Heat loss due to heat in atomizing steam, kcal/kg

Lb : Heat loss due to surface radiation and convection, kcal/kg

Lum : Unmeasured losses, kcal/kg

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3.9 Major Item of Heat Loss Calculation

Heat Loss of Boiler

(a) L_1 : Dry gas loss

$L_1 = C_{pg} G (T_g - T_o)$ (kJ/kg of fuel)

C_{pg} : Specific heat of dry gas (1.38kJ/m³N·K)

G : Dry gas flow (at outlet of air heater) (m³N/kg of fuel)

T_g : Exhaust gas temperature (at outlet of air heater) (℃)

T_o : Atmospheric temperature (℃)

(b) L_2 : Evaporation heat loss of water content due to combustion of hydrogen in fuel

$L_2 = \frac{9h}{100}\{2500 + 1.88(T_g - T_o)\}$ (kJ/kg of fuel)

h : Hydrogen in fuel (%)

(c) L_3 : Evaporation heat loss of water content in fuel

$L_3 = \frac{w}{100}\{2500 + 1.88(T_g - T_o)\}$ (kJ/kg of fuel)

w : Water content in fuel (%)

(d) L_4 : Heat loss due to moisture in air

$L_4 = 1.88 W_{ma} (T_g - T_o)$ (kJ/kg of fuel)

W_{ma} : Vapor quantity in air (kg/kg of dry air) × dry air quantity (kg/kg of fuel)

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3.10 Definition of Boiler Efficiency (ASME)

Heat Balance : **Qf + B = Qo + L**

Qo : Output as Steam Energy

Qf : Fuel Heat Input

B : Heat Credit (Which Converted in Boiler Such as Aux. Power)

L : Loss (Heat discharged to atmosphere)

Definition Formula: Two types of Definition

① **Gross Efficiency** (Output／Total Input)

$$\text{Efficiency} = \frac{Qo}{Qf+B} \times 100 = 100 - \left(\frac{L}{Qf+B}\right) \times 100$$

② **Fuel Efficiency** (Output／Fuel Heat Input)

$$\text{Efficiency} = \frac{Qo}{Qf} \times 100 = 100 - \left(\frac{L-B}{Qf}\right) \times 100$$

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3.11 Coal Analysis (1)

Example

Description	Unit	Performance	Design
Total Moisture (As fired basis)	% Wt	20	Max. 25
Proximate Analysis (Air dry basis)			
Moisture	% Wt	11.0	Max. 15.0
Volatile matter	% Wt	39.0	Min. 24.0
Fixed Carbon	% Wt	43.0	Max. 58.0
Ash	% Wt	7.0	Max. 15.0
Sulfur (Air dry basis)	%	0.45	Max. 0.80
Hardgrove Grindability Index	HGI	48	Min. 41
Size (2mm below)	%	40	-

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3.12 Coal Analysis (2)

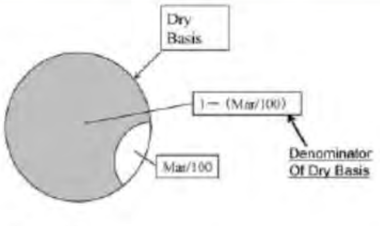
Description	Unit	Performance	Design
Ultimate Analysis(Dry basis)			
Carbon	%Wt	71.77	-
Hydrogen	%Wt	4.15	Min. 3.60
Nitrogen	%Wt	1.44	Max. 2.00
Oxygen	%Wt	14.71	-
Sulfur	%Wt	0.39	-
Ash	%Wt	7.54	-
Higher Heating Value			
As fired basis	kcal/kg	5,300	Min. 4,980
Air dry basis	kcal/kg	5,896	Min. 5,530
Dry basis	kcal/kg	6,625	-

3.13 Conversion of Basis of Coal Analysis

After Conversion / Before Conversion	Air Dry Basis (ad)	As received Basis (ar)	Dry Basis (d)	Dry Ash Free Basis (daf)
Air Dry Basis (ad)		$\frac{100-Mar}{100-Mad}$	$\frac{100}{100-Mad}$	$\frac{100}{100-(Mad+Aad)}$
As received Basis (ar)	$\frac{100-Mad}{100-Mar}$		$\frac{100}{100-Mar}$	$\frac{100}{100-(Mad+Aar)}$
Dry Basis (d)	$\frac{100-Mad}{100}$	$\frac{100-Mar}{100}$		$\frac{100}{100-Aad}$
Dry Ash Free Basis (daf)	$\frac{100-(Mad+Aad)}{100}$	$\frac{100-(Mar+Aar)}{100}$	$\frac{100-Mad}{100}$	

M; Moisture(%) A; Ash (%)

3.14 Conversion of Basis of Coal Analysis



[example]

As Received Basis → Dry Basis

3.15 Heating Value vs Coal Analysis

(1) Ultimate analysis result (Dulong Type Formula)

Higher heating value $H_h = \frac{1}{100}(8140c + 34400(h - \frac{o}{8}) + 2250s)$ (kcal/kg)

Where, c, h, o, and s are carbon, hydrogen, oxygen, and sulfur contents (mass %) in the fuel used.

(2) Industrial analysis result (Kosaka's equation)

$H_h = 81 c_f + (96 - \alpha \cdot w) \cdot (v_m + w)$ (kcal/kg)

Where, Hh is highen heating value, cf is fixed carbon (%), vm is volatile content (%), and w is water content (%). (α) is a coefficient depend on water content and as follows.

$w < 5.0$; $\alpha = 6.5$, $w \geq 5.0$; $\alpha = 5.0$

(3) How to find Hl from Hh

Lower heating value $H_l = H_h - 5.9\ (9h + w)$ (kcal/kg)

Where, h and w are the hydrogen and water contents (mass %) in the fuel used.

3.16 Calculation of Combustion Air

(1) Equations for theoretical amount of air and actual amount of air

(a) Equation for theoretical amount of air (A0)

(i) Solid/liquid fuel

$A_o = 11.49c + 34.5(h - \frac{o}{8}) + 4.3s$ (kg/kg fuel)

$A_o = 8.89c + 26.7(h - \frac{o}{8}) + 3.33s$ (m^3_N/kg fuel)

(ii) Gas fuel

$A_o = \frac{1}{0.21}\{0.5(H_2) + 0.5(CO) + \Sigma(x + 0.25y)[CxHy] - (O_2)\}$ (m^3_N/m^3_N fuel)

Where, c, h, o, and s indicate the mass ratio of each element in the fuel. [ ] indicatethe volume ratio, [CxHy] denotes volume ratio of various hychocarbons such as CH_4, C_2H_4, C_3H_6 etc.

(b) Equation for actual amount of air (A)

$A = m\,A_o$ where m indicates the air ratio.

3.17 Calculation of Gas Component (1)

(3) Exhaust gas content and amount.....

$(O_2) = 0.21(m - 1)A_o/V_d$

$(N_2) = (0.8n + 0.79mA_o)/V_d$

$$(CO_2)_{max} = \frac{(CO_2) + (CO)}{1 - \frac{(O_2)}{0.21} + \frac{0.79}{0.21} \cdot \frac{1}{2}(CO)} = \frac{0.21\{(CO_2) + (CO)\}}{0.21 - (O_2) + 0.395(CO)}$$

In case of $(CO) \doteqdot 0$, $(CO_2)_{max} = \frac{(CO_2)}{1 - (O_2)/0.21}$

( ) indicates the volume ratio of each element in the dry exhaust gas.

3.18 Calculation of Gas Component (2)

(a) For solid/liquid fuel ....

[illegible]

In case of $(N_2) = 0.79$, $m = \frac{0.21}{0.21-(O_2)}$

3.19 Sample Calculation of CO2 and SO2

Coal Composition

C %	H %	O %	N %	S %	Moisture	Ash %	Total
67.1	5.1	11.0	1.1	0.6	10.0	5.1	100

- **Discharge CO_2** (C : 12 → CO_2 : 44)

(Weight Base) : C x 3.6667

CO_2 exhaust coefficient= C (kg/kg Coal) ＊44/12= 0.671＊44/12=2.46 kg CO_2/ kg Coal

- **Discharge SO_2** (S : 32 → SO_2 : 64)

(Weight Base) : S x 2.0

SO_2 exhaust coefficient= S (kg/kg Coal) ＊64/32= 0.6＊64/32=1.2 kg SO_2/kg Coal

(Volume base) : S x 0.7

64g SO_2 → 22.4 Nℓ SO_2 = 22.4/1000 Nm^3 SO_2 1 kg SO_2 → 22.4/64 Nm^3 SO_2

SO_2 exhaust coefficient= S (kg/kg Coal) ＊(64/32)x(22.4/64)= S (kg/kg Coal) ＊22.4/32 =0.42 Nm^3 SO_2/ kg Coal

3.20 Conversion of SO2 and NO2

Conversion of SO2 and NO_2

SO_2 (mg → ppm)

64g SO_2 → 22.4 Nℓ SO_2 = 22.4/1000 Nm^3 SO_2

1mg SO_2 → 22.4/64/1,000,000 Nm^3 SO_2

SO_2 ppm= SO_2 mg＊22.4/64 = SO_2 mg＊**0.35**

NO_2 (mg → ppm) 14+32=46

1mg NO_2 → 22.4/46/1,000,000 Nm^3 NO_2

NO_2 ppm= NO_2 mg＊22.4/46 = NO_2 mg＊**0.487**

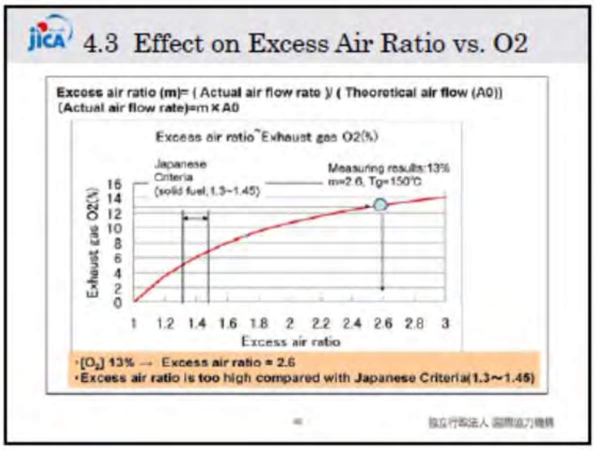
4. Emission Measures

4.1 Emission Measures

	Emission Measures	Effect
1	**Operate Boiler wih Higher Efficiecy**	Save Coal Consumption Reduce Exhaust Gas→SOx, NOx, Dust
2	**Good Quality Coal** ･Low Ash, Low S, Low N Coal	Reduce SOx, NOx, Dust
3	**Environmental Equipment** ･Dust Collector; ESP, Bag Filter ･De-SOx:FGD, CFB ･De-NOx:Low NOx Burner SCR, SNCR	Control SOx, NOx, Dust Emission

4.2 Improvement of Boiler Efficiency

	Item	Remarks
1	Reduce Exhaust Gas Heat Loss	
	a) Low Excess Air Combustion	to keep excess air as low as possible
	b) Low Exhaust Gas Temperature	to keep Heating Surface Clearn
2	Daily Management for Boiler Operation	
	a) Basic Unit of Power Generation	Deterination of Boiler Efficiency can be monitored by Coal/kWh
	b) Trend of Boiler Operation Data	Boiler Operation Data (Temp. Press. Draft, Flow, etc.) in each Shift shall be recorded
	c) Boiler Component	Condition of Equipment (Fans, Soot Blower, Pumps, Burner, etc.) shall be checked
3	Periodical Check	
	a) Coal Analysis	Analysis shall be done for Received Coal
	b) Instrument	Periodical Check is necessary


4.3 Effect on Excess Air Ratio vs. O2
Excess air ratio (m)= (Actual air flow rate)/ (Theoretical air flow (A0))
(Actual air flow rate)=m×A0
Excess air ratio~Exhaust gas O2(%)
Japanese Criteria (solid fuel,1.3~1.45)
Measuring results:13% m=2.6, Tg=150℃
Exhaust gas O2(%)
Excess air ratio
・[O2] 13% → Excess air ratio = 2.6
・Excess air ratio is too high compared with Japanese Criteria(1.3~1.45)
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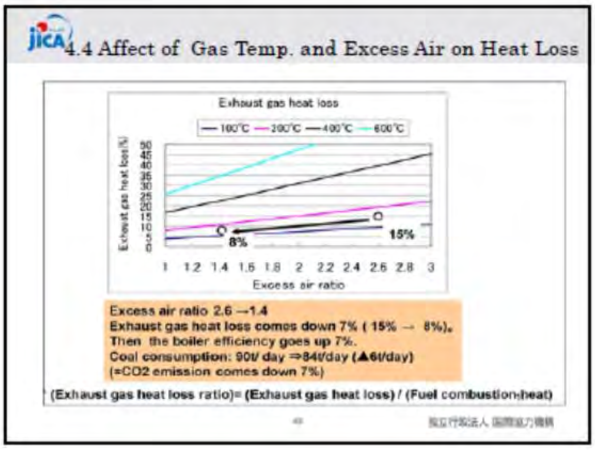
4.4 Affect of Gas Temp. and Excess Air on Heat Loss
Exhaust gas heat loss
100℃ 200℃ 400℃ 600℃
Exhaust gas heat loss(%)
8%
15%
Excess air ratio
Excess air ratio 2.6 →1.4
Exhaust gas heat loss comes down 7% (15% → 8%).
Then the boiler efficiency goes up 7%.
Coal consumption: 90t/ day ⇒84t/day (▲6t/day)
(=CO2 emission comes down 7%)
(Exhaust gas heat loss ratio)= (Exhaust gas heat loss) / (Fuel combustion heat)
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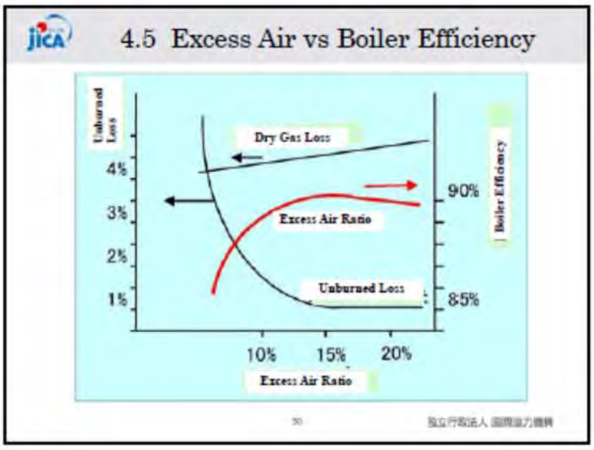
4.5 Excess Air vs Boiler Efficiency
Unburned Loss
Dry Gas Loss
Excess Air Ratio
Unburned Loss
Boiler Efficiency
4%
3%
2%
1%
90%
85%
10%
15%
20%
Excess Air Ratio
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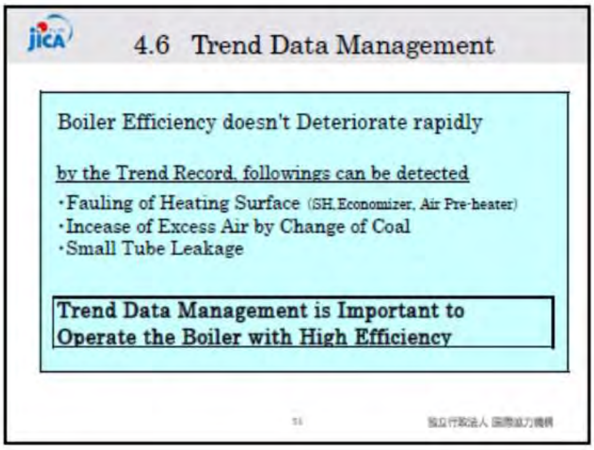
4.6 Trend Data Management
Boiler Efficiency doesn't Deteriorate rapidly
by the Trend Record, followings can be detected
・Fauling of Heating Surface (SH,Economizer, Air Pre-heater)
・Incease of Excess Air by Change of Coal
・Small Tube Leakage
Trend Data Management is Important to Operate the Boiler with High Efficiency
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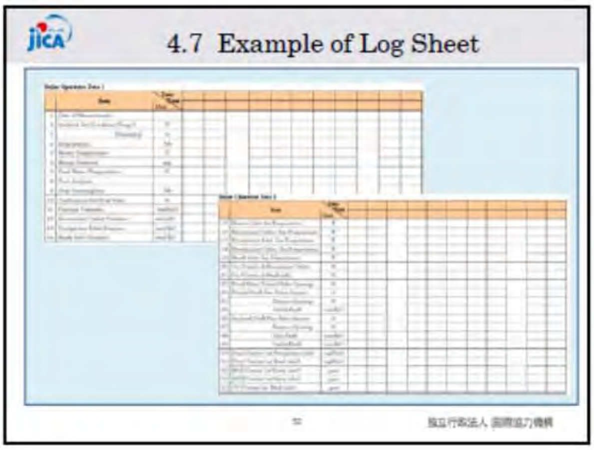
4.7 Example of Log Sheet
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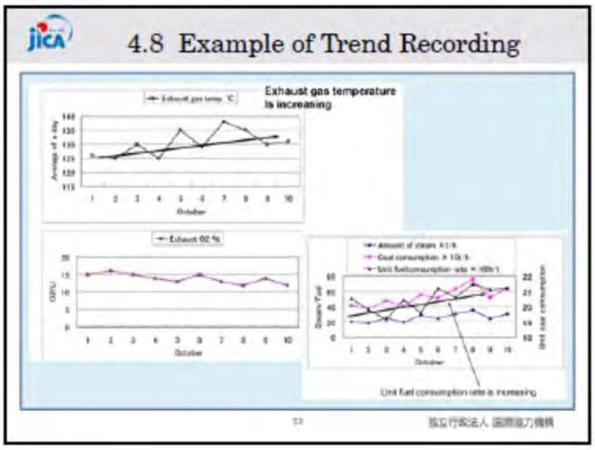
4.8 Example of Trend Recording
Exhaust gas temperature is increasing
Unit fuel consumption rate is increasing
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4.9 Operation of Coal Fired Boiler

Summary

It is Important

- To understand the Combustion Calculation as there is a close relation between Flue Gas Composition and Coal Analysis
- To operate the Boiler with High Efficiency in order to reduce Emission Products is
- To make suitable Operation/Maintenance of the Boiler in order to operate the Boiler with Best Condition

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Thank you for your cooperation

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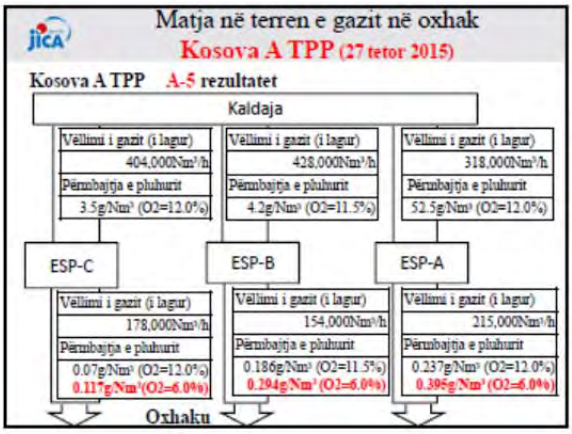
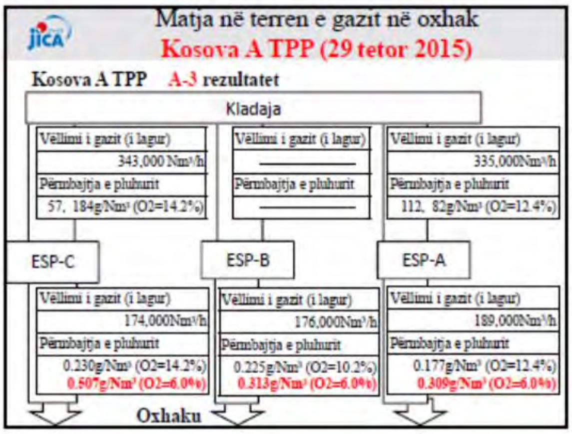
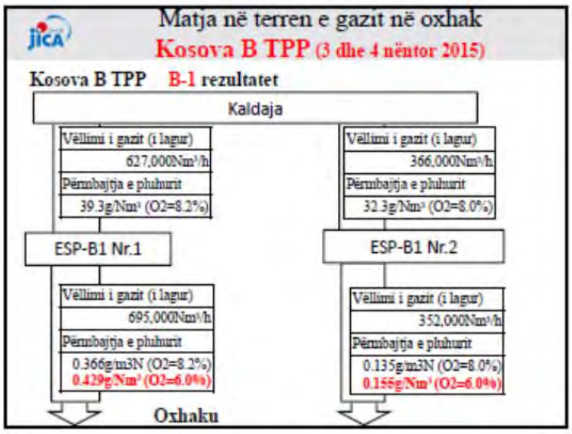
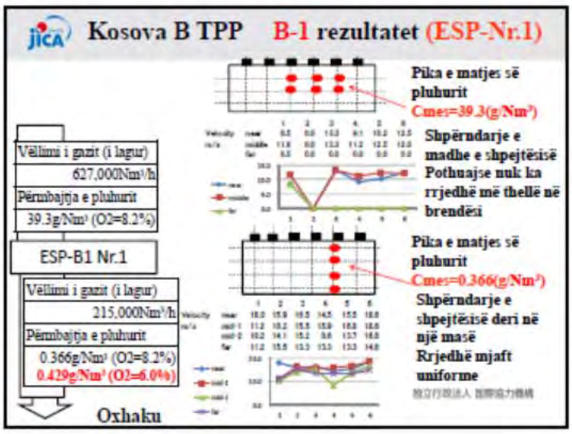
２－４－３　ワークショップ資料（アルバニア語）

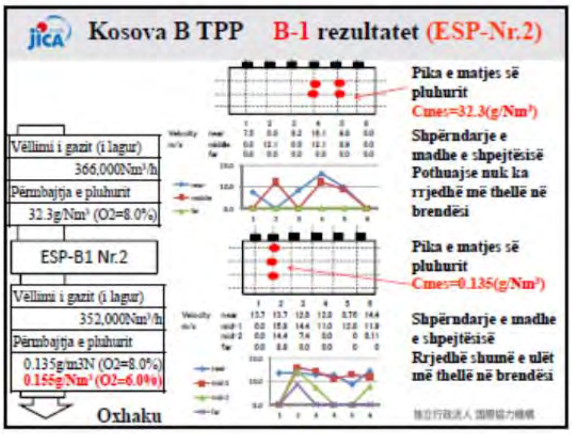
(1) Kosovo B TPP 測定結果

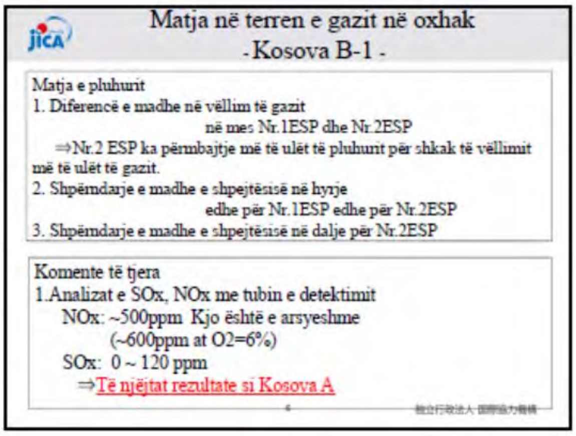


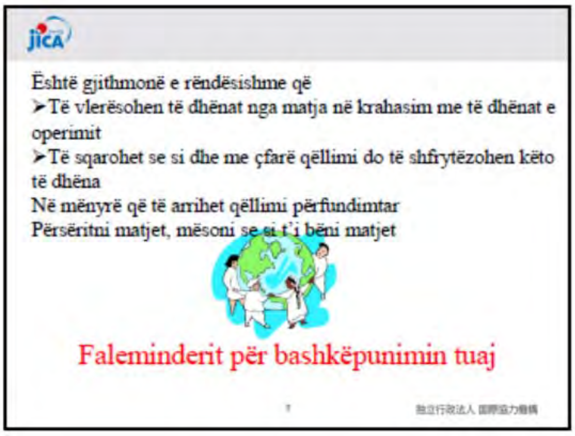









JICA
Matja në terren e gazit në oxhak
- Kosova B-1 -
Matja e pluhurit
1. Diferencë e madhe në vëllim të gazit
në mes Nr.1ESP dhe Nr.2ESP
⇒Nr.2 ESP ka përmbajtje më të ulët të pluhurit për shkak të vëllimit më të ulët të gazit.
2. Shpërndarje e madhe e shpejtësisë në hyrje
edhe për Nr.1ESP edhe për Nr.2ESP
3. Shpërndarje e madhe e shpejtësisë në dalje për Nr.2ESP
Komente të tjera
1.Analizat e SOx, NOx me tubin e detektimit
NOx: ~500ppm Kjo është e arsyeshme
(~600ppm at O2=6%)
SOx: 0 ~ 120 ppm
⇒Të njëjtat rezultate si Kosova A


JICA
Është gjithmonë e rëndësishme që
➢Të vlerësohen të dhënat nga matja në krahasim me të dhënat e operimit
➢Të sqarohet se si dhe me çfarë qëllimi do të shfrytëzohen këto të dhëna
Në mënyrë që të arrihet qëllimi përfundimtar
Përsëritni matjet, mësoni se si t'i bëni matjet
Faleminderit për bashkëpunimin tuaj

(2) ボイラ説明資料

Ekspert për Kontrollin e Ndotjes së Ajrit Punëtoria për

"Ndotjen e Ajrit dhe Kaldajën"

JICA Ekipi i Misionit
10 nëntor 2015
në Ministrinë e Mjedisit dhe Planifikimit Hapësinor

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Përmbajtjet

1. Kaldaja me Djegie të Qymyrit
2. Gjenerimi i Materieve Ndotëse
3. Efikasiteti i Kaldajës
4. Matjet e Emetimit

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1. Kaldaja me Djegie të Qymyrit

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1.1 Klasifikimi i Qymyrit (1)

Shkalla e Karbonizimit

E lartë ← E ulët

Klasifikimi i Qymyrit	Antraciti	Qymyri Bituminoz	Qymyri Nën-Bituminoz	Qymyri Bojë Kafe (linjiti)
Vlera e Nxehjes (kcal/kg)*	>8400	8100~ 8400	7300~ 8100	5500~ 7300
Përmbajtja e Karbonit (%)*	93~95	80~90	70~80	70

* Bazat e Thara dhe Pa Hi

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1.2 Klasifikimi i Qymyrit (2)

Shkalla e Karbonizimit

E lartë ← E ulët

Klasifikimi i Qymyrit	Antraciti	Qymyri Bituminoz	Qymyri Nën-Bituminoz	Qymyri Bojë Kafe (linjiti)
Norma e lëndës Djegëse (Karboni i Fiksuar)	> 4	1.5 ~ 4	1 ~ 1.5	< 1
Lagështia (%)*	< 10	< 15	15~30	30 ~ 60

* Bazat e Thara

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1.3 Karakteristikat e Qymyrit për Kaldajën e Planifikuar

Artikulli	Efekti
FC/VM	Lloji i Kaldajës, Djegësi
HHV	Madhësia e Kaldajës, Djegësi, Kapaciteti i Pajisjes
Lagështia	Madhësia e Kaldajës, Djegësi, Kapaciteti i Pluhurizimit
Hiri	Madhësia e Kaldajës, Djegësi, SH/RH/Eco
IDT e Hirit	Madhësia e Kaldajës, Muret e Furrës (Ndotja me Baltë Xeherore)
Analiza	Madhësia e Kaldajës, SH/RH (Ndotja)
S, Cl	Materiali, Temperatura e Metalit (Korrozioni)

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1.4 Efekti në Projektimin e Termocentralit

Cilësia e Qymyrit	Hi Qymyri i Lartë	Lagështi e Lartë. Qymyri
Transportimi	Kosto e Lartë	Kosto e Lartë
Deponimi	Zona e Gjerë	Zona e Gjerë
Efikasiteti i Kaldajës	E ulët	Edhe më e ulët
Erozioni	E lartë	—
Ndotja me Baltë Xeherore, Ndotja	—	E lartë
Deponimi i Hirit	I Vështirë	—
Tharja e Qymyrit të Pluhurzuar	—	Masë e Veçantë
Madhësia e Kaldajës	E Madhe	E Madhe
Kapaciteti i Pajisjeve Ndihmëse	E Madhe	E Madhe

1.5 Karakteristikat e Qymyrit për Kaldajën

	Materia e Paqë	Djegia	Ndotja me Baltë Xeherore,	Përdorimi	Lloji i Kaldajës
Linjiti	E lartë ↑	E mirë (*1) ↑	E Lartë ↑ (*2,*3)	Hyrja e Minierës	Speciale, CFB
Nën-Bituminoze			(*3)	Vendor	Normal PC, CFB
Bituminoz				Eksporti	
Gjysmë-Antracit				Vendor	Ndezës-U
Antracit	E ulët ↓	E varfër ↓	E ulët ↓	Hyrja e Minierës	

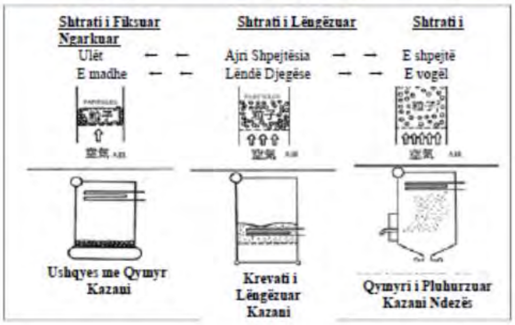
Vëreni

*1: I Varfër nëse përmbajtja e Lagështisë ose Hirit është e Lartë

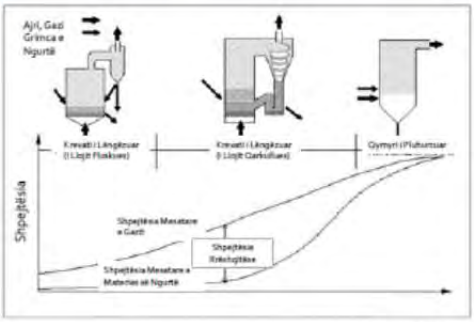
*2: Varet nga formimi fizik i Hirit

*3: Potencial i Lartë i Djegies Spontane

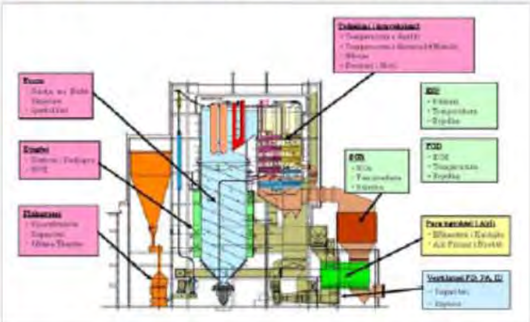
1.6 Lloji i Kaldajës për Djegie të Qymyrit



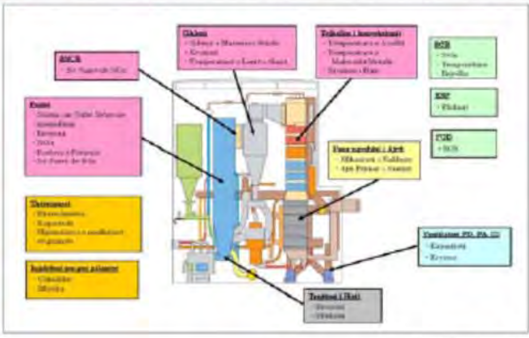
1.7 Shpejtësia e Gazit/Materies së Ngurtë në Furrë



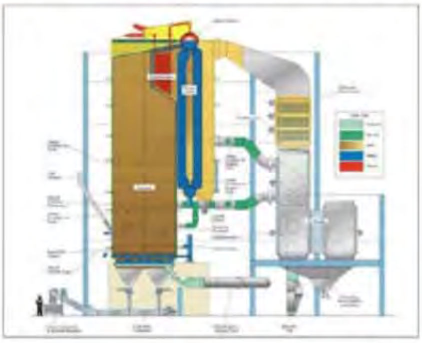
1.8 Kaldaja me Djegie të Qymyrit të Pluhurzuar



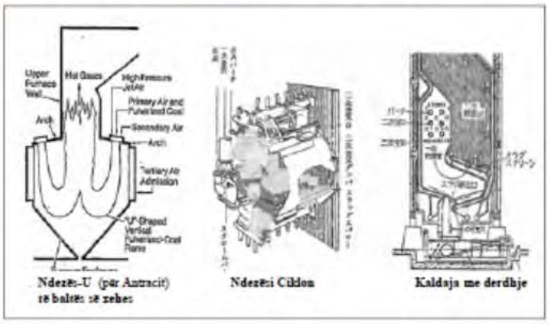
1.9 Kaldaja Djegëse me Krevat të Lëngëzuar Qarkullues (FBC)



1.10 Kaldaja Djegëse me Krevat të Lëngëzuar (FBC)



1.11 Kaldaja e Llojit të Veçantë



2. Gjenerimi i Materieve Ndotëse

2.1 Gjenerimi i materieve ndotëse të ajrit

1. <u>SOx</u> (SO_2, SO_3)

E gjeneruar nga S në Qymyr

S + O2 =SO2, SO2 + O2 = 2SO3

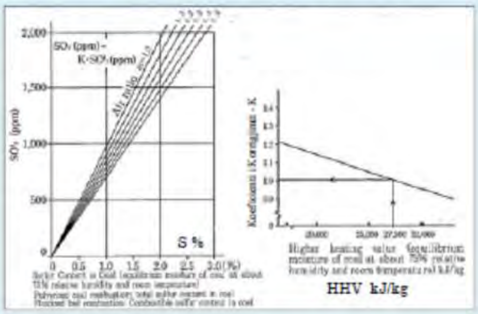
(norma e SO_3 në Kaldaja me Djegie të Qymyrit është e pakët)

2. <u>Pluhuri</u> (Hiri + Karboni i Padjegur);

I gjeneruar nga Hiri dhe Karboni në Qymyr

- Gjenerimi i Karbonit të Padjegur varet nga Sistemi i Djegies së Kaldajës dhe Norma e Ajrit Tepricë në Djegie
- Koncentrimi i pluhurit në Gazin e Oxhakut e prekur nga Shpërndarja e Pluhurit të Rënë (Fundor, Pajisja Ekonomizuese/Bartësi i Hirit, dhe deri në ESP)

2.2 Relacioni në mes përmbajtjes së S në Qymyr dhe Koncentrimi i SO2 në Gazin e Tharë të Oxhakut



2.3 Gjenerimi i materieve ndotëse të ajrit

3. <u>NOx</u> (NO, NO_2)

E gjeneruar në Procesin e Djegies nga N në Qymyr dhe N_2 në Ajrin nga Djegia

- <u>NOx Termale</u>

N2 +O = NO +O

N + O2 = NO + O

<u>Mekanizmi Zeldvich</u>

$$NO = Ae^{-\frac{E}{RT}}[N_2][O_2]^{\frac{1}{2}}t_e$$

A:Koeficienti, E:Aktivizo Energjinë
R:Konstanta e Gazit, T: Temp. e Flakës
Te: Koha e Mbajtjes në zonën e Temp.
N2, O2: dendësia(ppm)

- <u>NOX Lëndë Djegëse</u>

Norma e konvertimit të N në Lëndë Djegëse në NO është Përafërsisht15～30%

2.4 Djegie e Ulët e NOx

- Djegie e Ulët e Ajrit Tepricë
- Djegia me Dy Faza
- Gazi nga Oxhaku që Përzihet me Ajrin
- Djegës i Ulët i NOx
- Në Furrën de-NOx

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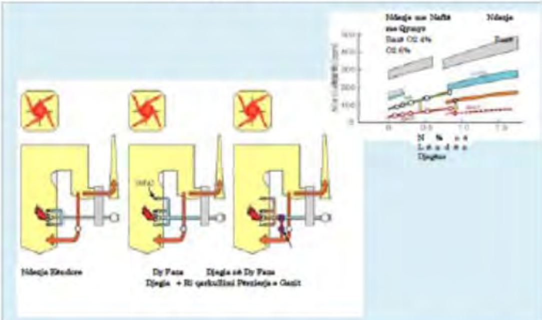
2.5 Djegie e Ulët e NOx (1)



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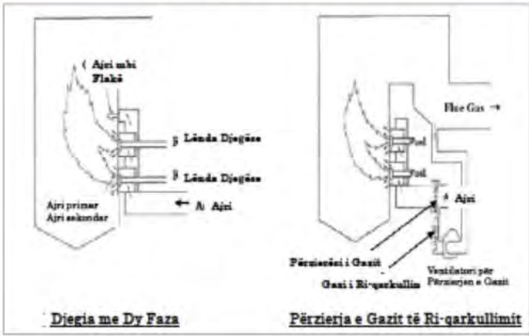
2.6 Djegie e Ulët e NOx (2)



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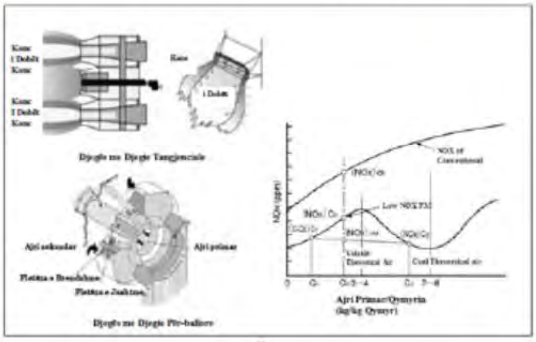
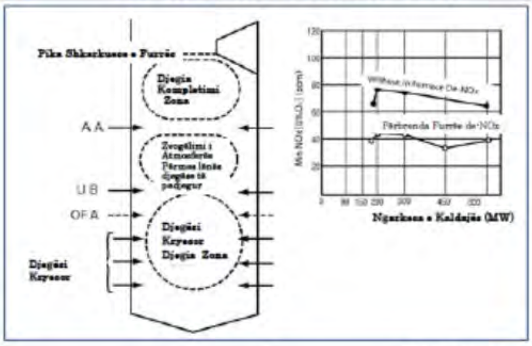
2.7 Djegës i Ulët i NOx



2.8 Zvogëlimi i NOx në Furrë



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3. Efikasiteti i Kaldajës

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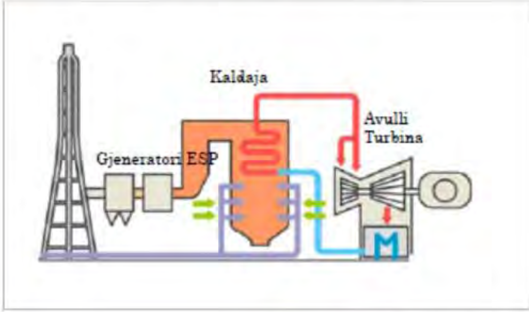
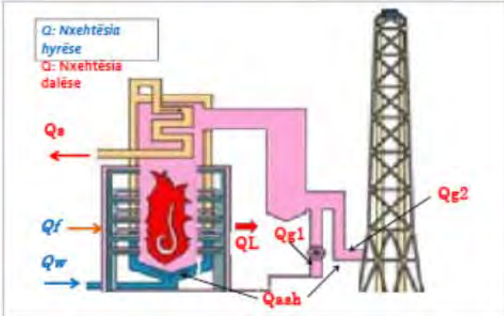
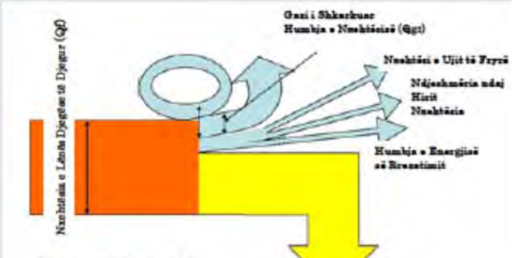
3.1 Termocentrali



3.2 Balancimi i Nxehtësisë së Kaldajës (1)



3.3 Balancimi i Nxehtësisë së Kaldajës (2)



Efikasiteti i Kaldajës Qs/Qf

Humbja e Nxehtësisë së Gazit të Shkarkuar = Qg2/Qf

3.4 Balancimi i Nxehtësisë së Kaldajës (2)

Nxehtësia Hyrëse = Energjinë e Avullit + Humbjen e Nxehtësisë
(Ligji i Parë i Termodinamikës)

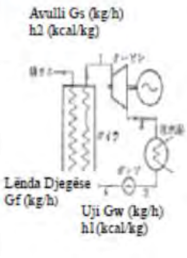
1. Nxehtësia Hyrëse: Qf (formulë e thjeshtësuar)
   Qf=Gf x HHV
   Gf: Rrjedha e Lëndës Djegëse (kg/h), HHV: Vlerë më e Lartë e Nxehtësisë (kcal/kg)
2. Nxehtësia Dalëse: Qs
   Qs=Wms x (isho –iFw) + WRs x (iRho –iRhi)
   Wms: Rrjedha e Avullit Kryesor (kg/h), WRs: Rrjedha e Avullit të Ri-nxehur
   isho: Entalpia e pikës SH të lirimit të avullit (kcal/kg), iFw
   iRho iRhi: Entalpia e avullit hyrës/dalës të Ri-nxehur (kcal/kg)
3. Humbja e Nxehtësisë

3.5 Tabela e Avullit

Compressed Water and Superheated Steam Table

Pressure(MPa) Saturation temperature(℃)		Temperature (℃)										
		150°	200°	250°	300°	350°	400°	450°	500°	550°	600°	650°
2.00 (212.38)	v	[illegible]	[illegible]	0.11140	0.12500	0.13849	0.15121	0.16354	0.17568	0.18760	0.19961	0.21145
	h	633.19	852.57	[illegible]	[illegible]	3137.64	[illegible]	[illegible]	[illegible]	[illegible]	3690.71	3803.79
	s	1.8403	2.3301	[illegible]	6.7085	6.9542	7.1296	7.2869	7.4335	7.5722	7.7042	[illegible]
3.0 ([illegible])	v	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.11619	[illegible]	0.13244	0.14045
	h	[illegible]	852.39	2856.55	2994.35	[illegible]	3231.57	[illegible]	3457.04	[illegible]	[illegible]	[illegible]
	s	1.8391	[illegible]	[illegible]	[illegible]	6.7449	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.0 (263.91)	v	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	s	[illegible]	2.3254	[illegible]	[illegible]	6.4515	6.5481	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7.0 ([illegible])	v	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	h	[illegible]	854.54	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3411.25	[illegible]	[illegible]	3760.41
	s	1.8347	2.3223	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	v	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

3.6 Efikasiteti i Termocentralit



Efikasiteti i Kaldajës
η_B= (Gs x h2-Gw x h1)/(Gf x Net vlera kalorifike)

Efikasiteti i turbinës
η_T= (N x 860(kcal/kW))/ (Gs x h2-Gw x h1)

Efikasiteti i termocentralit = η_B X η_T
η_P= (N x 860 (kcal/kW))/(Gf x Vlrat neto kalorifike)

3.7 Efikasiteti i Kaldajës (Detaj)

(Metoda e Nxehtësisë Hyrëse dhe Dalëse)

$$\text{Efikasiteti i Kaldа} = \frac{\text{Nxehtësia Da}}{\text{Nxehtësia Hy}} \times 100\ (\%)$$

(Metoda e Humbjes së Nxehtësisë)

$$\text{Efikasiteti i Kald} = \left(1 - \frac{\text{Humbja e N}}{\text{Nxehtësia H}}\right) \times 100\ (\%)$$

3.8 Nxehtësia Hyrëse e Kaldajës (Detaj)

Nxehtësia Hyrëse:

- Nxehtësia Hyrëse e Lëndës Djegëse;

Hf = Nxehtësia në lëndën djegëse, vlera më e lartë e nxehjes, kcal/kg

- Krediti i Nxehtësisë;

B = (Bae + Bze + Bfe + Bxe + Bma)/Wfe

B: Kreditë totale të nxehtësisë, kcal/kg

Bae: Nxehtësia e furnizuar nga ajri hyrës, kcal

Bze: Nxehtësia e furnizuar nga avulli atomizues, kcal

Bfe: Nxehtësia e ofruar nga nxehtësia e arsyeshme në lëndë djegëse, kcal

Bxe: Nxehtësia e ofruar nga shtytësit anësorë përbrenda mbështjellësit, kcal

Bma: Nxehtësia e furnizuar nga hyrja e lagështisë në ajër, kcal

Wfe: Norma e matur e lëndës djegëse, kg

3.8 Humbja e Nxehtësisë së Kaldajës (Detaj)

Humbja e Nxehtësisë:

L = Luc + Lg + Lmf + Lh + Lma + Lz + Lb + Lum

L: Totali i nxehtësisë së humbur nga generatori i avullit, kcal/kg

Luc: Nxehtësia e humbur për shkak të karbonit të padjegur në mbeturinë, kcal/kg

Lg: Humbja e nxehtësisë për shkak të nxehtësisë në gazin e tharë të oxhakut, kcal/kg

Lmf: Humbja e nxehtësisë për shkak të lagështisë në "si djegie e lëndës djegëse", kcal/kg

Lh: Humbja e nxehtësisë për shkak të lagështisë nga djegia e hidrogjenit, kcal/kg

Lma: Humbja e nxehtësisë për shkak të lagështisë në ajër, kcal/kg

Lz: Humbja e nxehtësisë për shkak të nxehtësisë në avullin atomizues, kcal/kg

Lb: Humbja e nxehtësisë për shkak të sipërfaqes rrezatuese dhe konveksionit, kcal/kg

Lum: Humbjet e pamatura, kcal/kg

3.9 Element Kryesor në Llogaritjen e Humbjes së Nxehtësisë

Heat Loss of Boiler

(a) L_1 : Dry gas loss

$L_1 = C_{dg} G\ (T_g - T_a)$ (kJ/kg of fuel)

C_{dg} : Specific heat of dry gas (1.38kJ/m³K)

G : Dry gas flow (at outlet of air heater) (m³N/kg of fuel)

T_g : Exhaust gas temperature (at outlet of air heater) (℃)

T_a : Atmospheric temperature (℃)

(b) L_2 : Evaporation heat loss of water content due to combustion of hydrogen in fuel

$L_2 = \frac{9h}{100}\{2500 + 1.88(T_g - T_a)\}$ (kJ/kg of fuel)

h : Hydrogen in fuel (%)

(c) L_3 : Evaporation heat loss of water content in fuel

$L_3 = \frac{w}{100}\{2500 + 1.88(T_g - T_a)\}$ (kJ/kg of fuel)

w : Water content in fuel (%)

(d) L_4 : Heat loss due to moisture in air

$L_4 = 1.88 W_{as}\ (T_g - T_a)$ (kJ/kg of fuel)

W_{as} : Vapor quantity in air(kg/kg of dry air)×dry air quantity (kg/kg of fuel)

3.10 Përkufizimi i Efikasitetit të Kaldajës(ASME)

Heat Balance : Qf + B = Qo + L

Qo Output as Steam Energy

Qf ; Fuel Heat Input

B ; Heat Credit (Which Converted in Boiler Such as Aux. Power)

L ; Loss (Heat discharged to atmosphere)

Definition Formula: Two types of Definition

① **Gross Efficiency** (Output／Total Input)

$$\text{Efficiency} = \frac{Qo}{Qf+B} \times 100 = 100 - \left(\frac{L}{Qf+B}\right) \times 100$$

② **Fuel Efficiency** (Output／Fuel Heat Input)

$$\text{Efficiency} = \frac{Qo}{Qf} \times 100 = 100 - \left(\frac{L\text{-}B}{Qf}\right) \times 100$$

3.11 Analiza e Qymyrit (1)

Shembull

Description	Unit	Performance	Design
Total Moisture (As fired basis)	% Wt	20	Max. 25
Proximate Analysis (Air dry basis)			
Moisture	% Wt	11.0	Max. 15.0
Volatile matter	% Wt	39.0	Min. 24.0
Fixed Carbon	% Wt	43.0	Max. 58.0
Ash	% Wt	7.0	Max. 15.0
Sulfur (Air dry basis)	%	0.45	Max. 0.80
Hardgrove Grindability Index	HGI	48	Min. 41
Size (2mm below)	%	40	-

3.12 Analiza e Qymyrit (2)

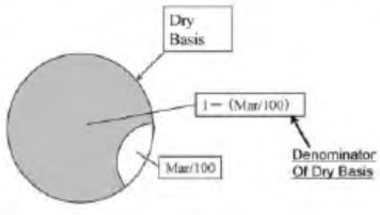
Description	Unit	Performance	Design
Ultimate Analysis(Dry basis)			
Carbon	%Wt	71.77	-
Hydrogen	%Wt	4.15	Min. 3.60
Nitrogen	%Wt	1.44	Max. 2.00
Oxygen	%Wt	14.71	-
Sulfur	%Wt	0.39	-
Ash	%Wt	7.54	-
Higher Heating Value			
As fired basis	kcal/kg	5,300	Min. 4,980
Air dry basis	kcal/kg	5,896	Min. 5,530
Dry basis	kcal/kg	6,625	-

3.13 Konvertimi i Bazës së Analizës së Qymyrit

Pas Konvertimit / Para Konvertimit	Bazat e Ajrit të Tharë (ad)	Bazat ashtu siç janë pranuar (ar)	Bazat e Thara (d)	Bazat pa hi të tharë (daf)
Bazat e Ajrit të Tharë (ad)		$\frac{100-Mar}{100-Mad}$	$\frac{100}{100-Mad}$	$\frac{100}{100-(Mad+Aad)}$
Bazat ashtu siç janë pranuar (ar)	$\frac{100-Mad}{100-Mar}$		$\frac{100}{100-Mar}$	$\frac{100}{100-(Mad+Aar)}$
Bazat e Thara (d)	$\frac{100-Mad}{100}$	$\frac{100-Mar}{100}$		$\frac{100}{100-Aad}$
Bazat pa hi të tharë (daf)	$\frac{100-(Mad+Aad)}{100}$	$\frac{100-(Mar+Aar)}{100}$	$\frac{100-Mad}{100}$	

M; Lagështia(%) A; Hiri (%)

3.14 Konvertimi i Bazës së Analizës së Qymyrit



[example]

As Received Basis → Dry Basis

3.15 Vlera e Nxehjes kundrejt Analizës së Qymyrit

(1) **Rezultati i Analizës Përfundimtare (Formula e Llojit Dulong)**

Higher heating value $H_h = \frac{1}{100}\left(8140c + 34400\left(h - \frac{o}{8}\right) + 2250s\right)$ (kcal/kg)

Where, c, h, o, and s are carbon, hydrogen, oxygen, and sulfur contents (mass %) in the fuel used.

(2) **Rezultati i Analizës Industriale (Ekuacioni i Kosakas)**

$H_h = 81\,cf + (96 - a \cdot w) \cdot (v_m + w)$ (kcal/kg)

Where, Hh is highen heating value, cf is fixed carbon (%), vm is volatile content (%), and w is water content (%). (a) is a coefficient depend on water content and as follows.

$w < 5.0 : a = 6.5,\ w \geq 5.0 : a = 5.0$

(3) Si ta gjejmë H_l nga H_h

Lower heating value $H_l = H_h - 5.9\ (9h + w)$ (kcal/kg)

Where, h and w are the hydrogen and water contents (mass %) in the fuel used.

3.16 Llogaritja e Ajrit nga Djegia

(1) **Ekuacionet për sasinë teorike dhe sasinë e vërtetë të ajrit**

(a) **Ekuacioni për sasinë teorike të ajrit (A0)**

(i) **Lënda djegëse e Ngurtë/Lëngët**

$A_o = 11.49c + 34.5\left(h - \frac{o}{8}\right) + 4.3s$ (kg/kg fuel)

$A_o = 8.89c + 26.7\left(h - \frac{o}{8}\right) + 3.33s$ (m^3_N/kg fuel)

(ii) **Lënda djegëse e Gazit**

$A_o = \frac{1}{0.21}\{0.5(H_2) + 0.5(CO) + \Sigma(x + 0.25y)(CxHy) - (O_2)\}$ (m^3_N/m^3_N fuel)

Where, c, h, o, and s | Trego normën e masës në çdo element në lëndën djegëse indicatethe volume ratio. [C_xH_y] denotes volume ratio of various hychocarbons such as CH_4, C_2H_4, C_3H_8, etc.

(b) **Ekuacioni për sasinë e vërtetë të ajrit (A)**

$A = m\,A_o$ Ku m paraqet normën e ajrit

3.17 Llogaritja e Komponentit të Gazit (1)

(3) **Përmbajtja dhe sasia e gazit të shkarkuar**

$(O_2) = 0.21(m - 1)A_o/V_d$

$(N_2) = (0.8n + 0.79mA_o)/V_d$

$$(CO_2)_{max} = \frac{(CO_2) + (CO)}{1 - \frac{(O_2)}{0.21} + \frac{0.79}{0.21} \cdot \frac{1}{2}(CO)} = \frac{0.21\{(CO_2) + (CO)\}}{0.21 - (O_2) + 0.395(CO)}$$

In case of $(CO) \doteqdot 0$, $(CO_2)_{max} = \frac{(CO_2)}{1 - (O_2)/0.21}$

( ) tregoni normën e vëllimit të çdo elementi në gazin e tharë të shkarkuar

3.18 Llogaritja e Komponentit të Gazit (2)

(6) Për Lëndën Djegëse të Ngurtë/Lëngët

3.19 Llogaritja Mostër e CO2 dhe SO2

Llogaritja e Shkarkimit të CO_2, SO_2, NOx

Përbërja e Qymyrit

C %	H %	O %	N %	S %	Lagështia	Hiri %	Totali
67.1	5.1	11.0	1.1	0.6	10.0	5.1	100

- **CO_2 e Shkarkuar** (C : 12 → CO_2 : 44)

(Bazë Pesha) : C x 3.6667

Koeficienti i shkarkimit të CO_2 = C (kg/kg Qymyr) × 44/12 = 0.671 × 44/12 = 2.46 kg CO_2/kg Qymyr

- **SO_2 e Shkarkuar** (S : 32 → SO_2 : 64)

(Bazë Pesha): S x 2.0

Koeficienti i shkarkimit të SO_2 = S (kg/kg Qymyr) × 64/32 = 0.6 × 64/32 = 1.2 kg SO_2/kg Qymyr

(Bazë Vëllimi): S x 0.7

64g SO_2 → 22.4 Nl SO_2 = 22.4/1000 Nm^3 SO_2 1 kg SO_2 → 22.4/64 Nm^3 SO_2

Koeficienti i shkarkimit të SO_2 = S (kg/kg Qymyr) × (64/32)×(22.4/64) = S (kg/kg Qymyr) × 22.4/32 = 0.42 Nm^3 SO_2/ kg Qymyr

3.20 Konvertimi i SO2 dhe NO2

Konvertimi i SO2 dhe NO_2

SO_2 (mg → ppm)

64g SO_2 → 22.4 Nl SO_2 = 22.4/1000 Nm^3 SO_2

1mg SO_2 → 22.4/64/1,000,000 Nm^3 SO_2

SO_2 ppm= SO_2 mg * 22.4/64 = SO_2 mg * **0.35**

NO_2 (mg → ppm) 14+32=46

1mg NO_2 → 22.4/46/1,000,000 Nm^3 NO_2

NO_2 ppm= NO_2 mg * 22.4/46 = NO_2 mg * **0.487**

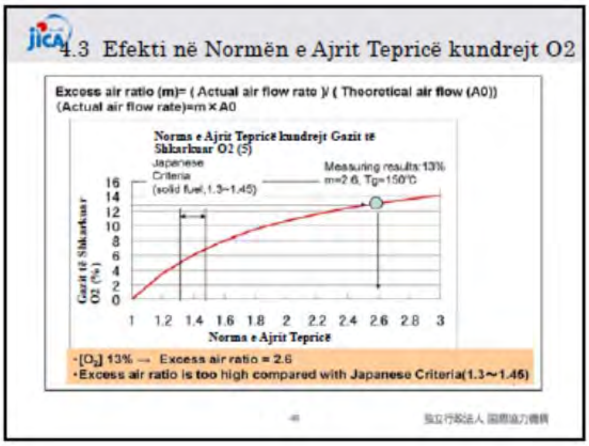
4. Matjet e Emetimit

4.1 Matjet e Emetimit

	Matjet e emetimit	Efekti
1	**Opero Kazanin me Efikasitet më të Lartë**	·Kurse Konsumimin e Qymyrit ·Zvogëlo Gazin e Shkarkuar →SOx, NOx, Pluhurin
2	**Qymyri i Cilësisë së Lartë** ·Hi i Ulët, s i Ulët, i Ulët Qymyr	·Zvogëlo SOx, NOx, Pluhurin
3	**Pajisjet Mjedisore** ·Mbledhësi i Pluhurit; ESP, Filtri me Qese ·De-SOx; FGD, CFB ·De-Nox: Djegës i Ulët i NOx SCR, SNCR	·Kontrollo Emetimin e SOx, NOx, Pluhurin

4.2 Përmirësimi i Efikasitetit të Kazanit

	Artikulli	Vërejtjet
1	**Zvogëlo Gazin e Shkarkuar Humbje e Ngrohjes**	
	a) Djegie e Ajrit me Tepricë të Ulët	për të mbajtur tepricën e ajrit sa më të ulët që ë është e mundur
	b) Temperaturë e Ulët e Gazit të Shkarkuar	për të mbajtur Pastër Sipërfaqen Ngrohëse
2	**Menaxhimi Ditor i Operimit të Kazanit**	
	a) Njësia Bazike e Gjenerimit të Energjisë Elektrike	Përkeqësimi i Efikasitetit të Kazanit mund të monitorohet me Qymyr/kWh
	b) Trendi i të Dhënave për Operimin e Kazanit	Të Dhënat për Operimin e Kazanit (Temp. Pres. Rrymimi, Rrjedha, etj.) të regjistrohet në çdo turn
	c) Komponentët e Kazanit	Gjendja e Pajisjeve (Ventilatorët, Fryrësat i Blozës, Pompat, Furra për Djegie, etj.) duhet të kontrollohet
3	**Kontrolli Periodik**	
	a) Analiza e Qymyrit	Analizat duhet të bëhen për Qymyrin e Pranuar
	b) Instrumenti	Kontrolli Periodik është i nevojshëm


4.3 Efekti në Normën e Ajrit Tepricë kundrejt O2
Excess air ratio (m)= (Actual air flow rate)/ (Theoretical air flow (A0))
(Actual air flow rate)=m × A0
Norma e Ajrit Tepricë kundrejt Gazit të Shkarkuar O2 (5)
Japanese Criteria (solid fuel,1.3~1.45)
Measuring results:13% m=2.6, Tg=150°C
Gazit të Shkarkuar O2 (%)
Norma e Ajrit Tepricë
・[O2] 13% → Excess air ratio = 2.6
・Excess air ratio is too high compared with Japanese Criteria(1.3～1.45)
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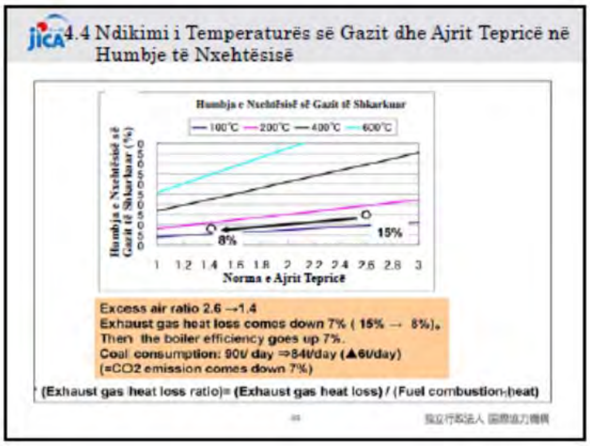
4.4 Ndikimi i Temperaturës së Gazit dhe Ajrit Tepricë në Humbje të Nxehtësisë
Humbja e Nxehtësisë së Gazit të Shkarkuar
100°C 200°C 400°C 600°C
Humbja e Nxehtësisë së Gazit të Shkarkuar (%)
8%
15%
Norma e Ajrit Tepricë
Excess air ratio 2.6 →1.4
Exhaust gas heat loss comes down 7% (15% → 8%).
Then the boiler efficiency goes up 7%.
Coal consumption: 90t/ day ⇒84t/day (▲6t/day)
(=CO2 emission comes down 7%)
(Exhaust gas heat loss ratio)= (Exhaust gas heat loss) / (Fuel combustion heat)
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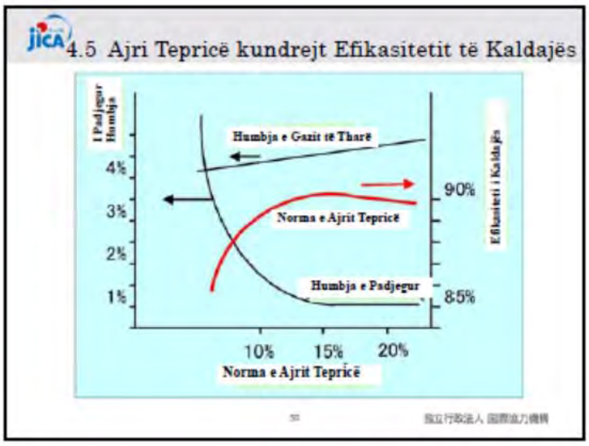
4.5 Ajri Tepricë kundrejt Efikasitetit të Kaldajës
Humbja I Padjegur
Humbja e Gazit të Tharë
Norma e Ajrit Tepricë
Humbja e Padjegur
Efikasiteti i Kaldajës
4%
3%
2%
1%
90%
85%
10%
15%
20%
Norma e Ajrit Tepricë
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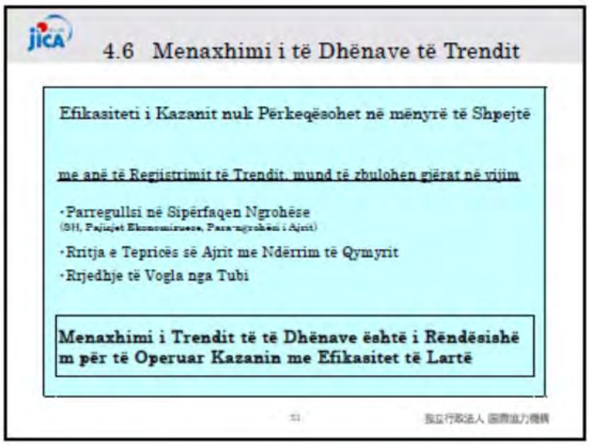
4.6 Menaxhimi i të Dhënave të Trendit
Efikasiteti i Kazanit nuk Përkeqësohet në mënyrë të Shpejtë
me anë të Regjistrimit të Trendit, mund të zbulohen gjërat në vijim
・Parregullsi në Sipërfaqen Ngrohëse
(SH, Pajisjet Ekonomizuese, Para-ngrohësi i Ajrit)
・Rritja e Tepricës së Ajrit me Ndërrim të Qymyrit
・Rrjedhje të Vogla nga Tubi
Menaxhimi i Trendit të të Dhënave është i Rëndësishëm për të Operuar Kazanin me Efikasitet të Lartë
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4.7 Shembuj të Fletës Regjistruese
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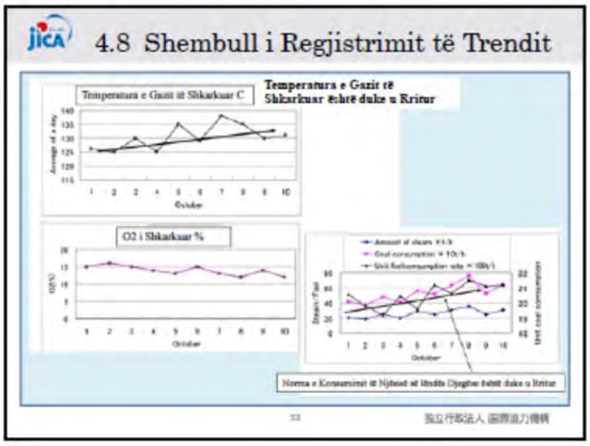
4.8 Shembull i Regjistrimit të Trendit
Temperatura e Gazit të Shkarkuar C
Temperatura e Gazit të Shkarkuar është duke u Rritur
October
O2 i Shkarkuar %
October
October
Norma e Konsumimit të Njësisë të Ifmdës Djegëse është duke u Rritur
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4.9 Operation of Coal Fired Boiler

Përmbledhja

Është e Rëndësishme

- Te mesohet kalkulimi i djegjes pasiqe eshte nje lidhje e afert mes <u>Perberjes se gazit te rrjedhshem</u> dhe <u>Analizave te Qymyrit</u>
- Operimi i kaldajes me efikasitet te larte do te reduktoje prodhimin e emisionit
- Me Operim/Mirembajtje te pershtatshme kaldaja do te operoje ne kushte me te mira.

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Faleminderit për bashkëpunimin tuaj

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