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VISIT REPORT

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Fuel Switching Pilot Project Technical Support to Afar Amibara and National Cement, Dire Dawa

Prepared for:

European Union Delegation to Ethiopia

Prepared by:

Ufuk Durgut

Contributed by:

Addisu Amare

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1. Introduction

This report provides an overview of the visit conducted to the Prosopis Juliflora harvest area in Afar Amibara and to the National Cement Plant. The objective of the visit was to see the current progress on sites and to identify and present potential improvements, if any, both at the harvest site and at the cement plant.

Key Findings - Harvest Area in Afar Amibara

Biomass Availability: The visit confirmed that the Prosopis Juliflora species is abundantly in the designated harvest area, providing a potential biomass source for the cement industry. The plant's rapid growth and high energy content make it a suitable candidate for biomass fuel.

Energy Content and Combustion Characteristics: There are relatively young trees in the area, especially since the aged trees are harvested by the nearby villagers to make charcoal. In this case, it should be expected that the moisture content is high and the calorific value of the biomass is relatively low with its undersized branches and trunk.

Sustainability and Environmental Benefits: Utilizing Prosopis Juliflora biomass in the cement process offers environmental advantages, including reduced greenhouse gas emissions and decreased reliance on non-renewable resources. The plant's invasive nature also presents an opportunity to control its spread while harnessing its biomass potential.

Feasibility and Cost Analysis: Preliminary economic analysis indicates that the use of Prosopis Juliflora biomass in the cement process can provide cost savings compared to traditional fuel sources. Increasing fuel (coal) prices, especially due to the pandemic and the tension between Russia and Ukraine afterwards, increase the value of biomass many times over. The availability of the biomass locally can reduce transportation costs and dependency on imported fuels.

Stakeholder Collaboration: The visit emphasized the importance of collaboration between cement manufacturers, local communities, and relevant government bodies. Engaging stakeholders in the harvesting, processing, and supply chain management of Prosopis Juliflora biomass can foster socio-economic development while ensuring sustainable practices.

The National Cement Plant

The National Cement Plant, known for its commitment to sustainable practices, embarked on this trial burning initiative as part of its ongoing efforts to explore alternative energy sources and reduce carbon emissions associated with cement manufacturing. This visit aimed to evaluate the technical viability, environmental implications, and potential economic benefits of utilizing Prosopis Juliflora as a fuel alternative within the cement production process.

The purpose of this visit was to evaluate the preparation and readiness of the cement factory to undertake the trial burning process using Prosopis Juliflora.

2. Harvest area in Afar Amibara

The visit aimed to assess the progress and effectiveness of the operations at the site and identify areas where improvements are necessary. The observations reveal that several aspects of the harvest site's operations are open to improve, and significant challenges have been encountered.

The report will delve into the specific observations made during the visit and provide an analysis of the challenges identified. It will also offer practical recommendations aimed at addressing these issues and improving the overall performance and sustainability of the Prosopis Juliflora harvest site.

By thoroughly examining the existing problems and proposing viable solutions, this report seeks to guide stakeholders involved in the management and operations of the harvest site towards implementing measures that will enhance efficiency and productivity.

The findings and recommendations presented in this report are intended to facilitate informed decision-making and foster constructive dialogue among relevant stakeholders. It is our hope that the report's insights will serve as a catalyst for positive change, ultimately leading to the effective and sustainable management of Prosopis Juliflora at the harvest site.

In the subsequent sections, we will discuss the specific observations made during the visit, followed by a detailed analysis of the challenges encountered. The report will then conclude with actionable recommendations designed to address these challenges and improve the overall performance of the Prosopis Juliflora harvest site.

Observations and Findings at HARVEST AREA

- 4 people are being trained for Awash and 4 people for Shinle (PJ area closer to National Cement Plant) areas. These operators are trained to both drive the vehicles and perform their maintenance.
- Within 5 months of activity, it is almost impossible to operate in half the time due to insufficient fuel. Even in this case, both the harvester machine and the derooter are operated.
- It is seen that PJs grow again in a very short time from the seeds remaining in the area ready for agricultural activity after rooting.

5-month-old seedlings

- Old (thick) trees are cut down by the locals to make charcoal,
- In the remaining young trees, while the trunk is small, the branches and leaves are relatively more
- In this case;
- Due to the relatively high percentage of leaves and branches, the moisture content will be high,
- The high moisture it contains will naturally extend the drying time,
- It is possible that even if it is dried to 10% levels, the net heat value of the harvested PJ will probably be low.

Recommendations

- For the estimation of the drying time, the necessary sampling study can be done to reach the target value of 10% humidity. Moisture content can be checked by taking 1 sample every 3 days and analyzed at chosen lab (National Cement Plant lab).
- Instead of making the pile conical, the surface can be expanded and made more flat in order to increase the drying speed.

Conical PJ pile

- In the current situation, it is seen that the piles are in a scattered state. Gathering and classifying the piles in a certain area will make things much easier. Classification can be made according to PJs harvested in a certain period (eg weekly) plot by plot (Plot A, Plot B..). This will facilitate the drying follow-up and the shipment of the dried ones to the factory.
- To increase drying efficiency, the pile can be reversed 2-3 times a day.
- Our recommendation is to run only the harvester machine until enough fuel is obtained, and the essential thing is to send the biomass to the cement plant as soon as possible and in sufficient quantity.
- Even when derooting was done, it was observed that new PJ sprouts came because of the seeds and agricultural activities were not started. When derooting is left for later, both these new shoots and the roots will be removed.

- Roots remaining on the soil surface after derooting can be stacked on the right or left of the road, by means of an angled fork to be attached to the back of the derooting vehicle.

Roots after the derooting

- Locals who make a living from the charcoal business might be allowed to collect these roots. This ensures a smooth transition for them until the next step, when the locals will use these areas as agricultural activities.
- If a system is established for tracking spare parts, wearing parts and consumables (greases and lubricants etc.) for harvester and derooter, delays can be prevented by placing an order on time. In order to prepare for the supply of materials related to the system created, after the list is created, the suppliers can be contacted and the price and delivery time information can be obtained and processed into the system. Sourcing of materials from within Ethiopia can also be explored.

3. National Cement Plant (Dire Dawa)

This report aims also to provide a comprehensive analysis of the observations made during our recent visit to the National Cement Plant, specifically focusing on the installation set up to burn Prosopis Juliflora as biomass. The visit was conducted to assess the progress, efficiency, and impact of utilizing Prosopis Juliflora as a renewable energy source in the cement manufacturing process.

The utilization of Prosopis Juliflora as a biomass fuel presents an opportunity to address environmental concerns associated with traditional fossil fuel usage and contribute to sustainable development goals.

The purpose of our visit was to evaluate the installation's operational efficiency and the overall viability of using Prosopis Juliflora as a biomass feedstock in the cement manufacturing process. We conducted detailed observations and assessments to identify strengths, weaknesses, and potential areas for improvement.

In this report, we will present our findings and analysis based on the observations made during the visit.

Key aspects:

<u>Installation and Infrastructure:</u> The design, configuration, and overall effectiveness of the installation set up to burn Prosopis Juliflora as biomass had been evaluated. This includes examining the equipment, storage facilities, and related infrastructure necessary for the biomass burning process.

<u>Operational Efficiency:</u> The efficiency of the biomass burning process, considering factors such as fuel consumption, heat generation, and combustion efficiency had been assessed. Analysis will highlight any challenges or areas where improvements can be made to enhance operational efficiency.

<u>Environmental Impact:</u> Facility management was advised to examine the environmental impact of burning Prosopis Juliflora as biomass, including emissions monitoring, air quality control measures and the overall carbon footprint of the cement plant.

The insights and recommendations provided in this report aim to support the cement plant in optimizing the utilization of Prosopis Juliflora as a sustainable biomass fuel. By identifying areas for improvement and suggesting best practices, we intend to contribute to the plant's environmental performance, operational efficiency, and overall sustainability.

It is important to note that the observations and recommendations outlined in this report are based on our visit and analysis conducted at a specific point in time. Future developments and changes may require further assessments and adjustments to ensure continuous improvement in the utilization of Prosopis Juliflora as a biomass feedstock at the cement plant.

Observations and Findings at the Plant

- Even the fact that the CEO came to the opening meeting and made a presentation shows how much they care and dedicate to the project.
- National Cement sent 2 CCR operators to the cement plant in Congo, which has a very similar biomass system that is currently in operation, and they received training.

- National Cement has installed both pneumatic and mechanical systems for the pilot system with its own means. They have built these systems with equipment that most of them have idle.


Pneumatic Feed & Dosing


Mechanic Feed & Dosing

- There are also investments that include shredders and hammer crushers to reduce field harvested PJ dimensions to 15 x 2 x 2 mm that is totally useful for good combustion where the precalciner has short retention time (3.5 s in National Cement Kiln). We visited the place where these equipment were manufactured; They have previously produced similar equipment/systems for agricultural products close to the characteristics of PJ, where the manufacturing company has mastered the subject.


Shredder Internals


Hammer Mill Internals

- The technical team accompanied us during the detailed site visit at the factory. We evaluated the studies for the pilot test together. For better preparation and improvements, I have given the following suggestions;

Recommendations

- PJs from the harvest area and downsized PJs (product) passed through the shredder & crusher should be stocked in an isolated area in the plant to reduce the risk of fire. Activities that may cause fire (smoking, welding, etc.) should not be allowed in this area.
- In case of fire in the PJs where stocks are made, stockpiles divided by clay piles should be created. When a fire occurs, the clay piles around the area can be extinguished by pushing the clay piles with the help of a dozer and/or a loader.
- Since the precision of the biomass feeding system is not high, it is necessary to continue to balance the precalciner outlet temperature (which uses the National Cement bottom cyclone outlet temperature) with coal.
- Even when a high rate of biomass use is targeted, coal with more precise dosing accuracy should be used to minimize fluctuation. However, the minimum coal feed tonnage (one tenth of the design capacity) should not be exceeded to the lower amounts..
- The design throughout the entire system should be arranged to prevent the accumulation of PJ dust. If accumulations occur, they should be cleared every shift to minimize the risk of fire. Especially inside of the crushers and shredder.
- If they experience flow problems that will cause deviations in feeding and dosing, they can mount a vibrator on the pneumatic system hopper.

Pneumatic line feeding hopper

- Pilot system pneumatic line pipe enters the precalciner line (tangentially) from the proper location. If refractory wear is encountered in the place opposite the point of entry (inside the calciner) after a certain operating time, the connection pipe can be lifted upwards, approximately 10-15 degrees to the ground, in the same position.

Bottom of precalciner/pneumatic line connection

- In order to reduce the risk of abrasion, wider angled elbows can be used instead of the last elbow placed at 90 degrees. In addition, it will be beneficial to cover it with wear-resistant materials.

90 degrees elbow on the pipe

- A shut-off gate should be placed in the mechanical supply system in order to reduce the risk of high-temperature gas coming from the precalciner, which is under high positive pressure, in power cuts, entering the mechanical system and causing a fire. Shut-off gate can be mounted just above the cell wheel on the supply pipe for reliable operation.

Mechanic System connection chute.

- If the newly manufactured crusher and shredder cannot meet the capacity, the grid can be replaced with one with wider mesh ranges. In this case, the product size of 30 x 2 x 2 mm should not be exceeded.
- In this way, if larger product sizes are to be worked on, the bottom cyclone's transfer connection must be visually checked inside the hot meal pipe by open a poke hole, and sparks, which are the signs of bad combustion, should not be seen.

Bottom cyclone hot meal pipe and sparks

- The feeding and dosing system, which is planned permanently after the pilot facilities, will be built predominantly mechanically. It is stated that the pneumatic part is at the final feeding point and it will be possible to enter the oven system from outside. For reference, the loss of National Cement with an air intake of only 1,000 m3/h is calculated to be over 200,000 USD annually.

Cold air amount, VFL, D, tr, h=	1000	Nm3tr/h
H, specific heat loss from kiln outlet sealing =	2.2	kcal/kg cli

Ts (caliner gas temperature)	900	C
T (pneumatic air temperature)	45	C
Clinker Production, hourly	125,000	kg cli/h
Clinker Production, annual	960,000	TPY
Calorific loss, annual	2,119,367	kcal/year
Coal calorific value	6,000	kcal/coal
Coal loss, annual	353	TPY
Coal Price	600	USD/ton
Annual LOSS	211,937	USD/year

- We recommend the use of mechanical systems as much as possible for less false air in facilities with very high fuel costs.

4. Conclusion

The visit conducted to the Prosopis Juliflora harvest area in Afar Amibara has provided valuable insights into the potential improvements that can be made regarding the utilization of this invasive plant species. The observations made during the visit shed light on various aspects that can contribute to enhancing the efficiency and effectiveness of Prosopis Juliflora harvesting.

It was evident that there is a significant abundance of Prosopis Juliflora in the area, highlighting the potential for utilizing this invasive species as a valuable resource. However, it is crucial to develop efficient harvesting techniques and strategies to maximize the extraction of usable biomass while minimizing resource wastage. This can be achieved through the implementation of appropriate harvesting equipment, training of workers, and the establishment of standardized harvesting protocols that are already succesfully implemented on site.

Additionally, community engagement and awareness were identified as crucial factors for the sustainable management and utilization of Prosopis Juliflora. Educating local communities about the ecological impact of this invasive species, as well as the economic and environmental benefits of its utilization, can foster support and active participation in harvesting initiatives. This can be achieved through community outreach programs, workshops, and the establishment of cooperative structures that involve local communities in the harvesting and processing activities.

In conclusion, the visit to the Prosopis Juliflora harvest area in Afar Amibara has highlighted several areas where potential improvements can be made. Such improvements will not only contribute to mitigating the ecological impact of this invasive species but also foster economic development and create sustainable livelihood opportunities for local communities.

Moving forward, it is recommended to collaborate with relevant stakeholders, including government agencies, research institutions, and local communities, to implement the identified improvements. By working collectively and much effectively, it is possible to harness the potential of Prosopis Juliflora and transform it into a valuable and sustainable resource for various applications, thereby addressing both environmental and socio-economic challenges in the region.

The visit to the National Cement Factory to assess the readiness for the trial burning of Prosopis Juliflora has provided valuable insights into the factory's preparedness for utilizing this renewable energy resource. The findings and observations from the visit offer a comprehensive overview of the infrastructure, procedures, and stakeholder engagement strategies in place.

Overall, the National Cement Factory has demonstrated a enough level of readiness for the trial burning of Prosopis Juliflora. The factory's existing infrastructure, including the cement kilns and combustion systems, appears suitable to accommodate the utilization of this biomass fuel. Necessary modifications and adaptations, such as fuel preparation and handling procedures, have been implemented, ensuring the efficient and safe utilization of Prosopis Juliflora.

The factory has plans in place to involve regulatory bodies, and other stakeholders in the trial burning process, fostering transparency, collaboration, and the dissemination of information regarding the project's objectives and potential benefits.

Based on the readiness assessment, it is recommended that the National Cement Factory proceed with the trial burning of Prosopis Juliflora. However, continuous monitoring and evaluation of the process should be carried out to ensure optimal performance, adherence to environmental standards, and mitigation of any unforeseen challenges that may arise.

Successful implementation of this trial will contribute to reducing carbon emissions associated with cement manufacturing while promoting the utilization of invasive species as a valuable resource.

In conclusion, the National Cement Factory has exhibited of readiness for the trial burning of Prosopis Juliflora. The factory's commitment to sustainability, coupled with the appropriate infrastructure, procedures, and stakeholder engagement strategies, positions it well for a successful trial. By embracing this innovative approach, the factory can pave the way for a more environmentally friendly and economically sustainable future in the cement industry.