Project Report on

Control For Plasma Gasification

Submitted in partial fulfilment of the requirements
of Project Based Learning of

BACHELOR OF ENGINEERING

in

COMPUTER ENGINEERING

(A.Y. 2021-2022)

by

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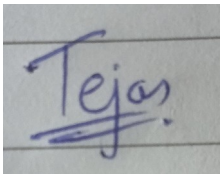
Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.



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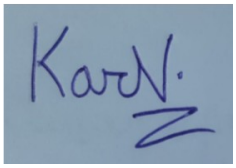
Tejas Nair (Roll No. 33)



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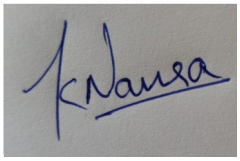
Kartik Nambiar (Roll No.34)



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Taranveer Nanra (Roll No. 35)

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Gaurav Padam (Roll No.36)

Date: 16/11/2021

Abstract

Plasma arc gasification (PAG), waste-treatment technology that uses a combination of electricity and high temperatures to turn municipal waste (garbage or trash) into usable by-products without combustion (burning). Although the technology is sometimes confused with incinerating or burning trash, plasma gasification does not combust the waste as incinerators do. Instead, it converts the organic waste into a gas that still contains all its chemical and heat energy and converts the inorganic waste into an inert vitrified glass called slag. The process can reduce the volume of waste sent to landfills and generate electricity. In this project, we are simulating an apparatus capable of Plasma Gasification, and we making a GUI that has the capability of controlling the gases to keep the temperature of the setup in check. It maintains the flow of gases so that its never deviating from the ideal conditions, while being flexible enough to modify the conditions, within reason. We first provide it with the type of waste that we are going to incinerate. The program will give us the ideal temperature that would be needed for this waste to be converted into slag with most efficiency. We can change the temperature given to us by the program how much ever we want, by modifying the flow of gases and changing the electrode to suit our needs. Our motivation for this project was simply spreading awareness of the process of plasma gasification and just how flexible and efficient it can be, compared to landfills and burning of waste that is so common in India. This lines up with our objective, which is not only to become better at coding, but also becoming competent enough to learn to help our nation progress in the later years.

List of Contents

Abbreviations and Symbols

GTK	GIMP ToolKit
GIMP	GNU Image Manipulation Program
GNU	GNU's not Unix

Motivation

Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects. The tasks of solid-waste management present complex technical challenges. They also pose a wide variety of administrative, economic, and social problems that must be managed and solved. The Sole motivation of this project lies upon finding a solution for the above mentioned problem.

Objective

Using Plasma Gasification process, We intend to find a solution for these landfills. In the PAG process an electrical arc gasifier passes a very high voltage electrical current through two electrodes, creating an arc between them. Inert gas, which is under high pressure, then passes through the electrical arc into a sealed container (called a plasma converter) of waste materials. Temperatures in the arc column can reach more than 14,000 °C (25,000 °F), which is hotter than the surface of the Sun. Exposed to such temperatures, most waste is transformed into gas consisting of basic elements, while complex molecules are torn apart into individual atoms.

Plasma gasification is an emerging technology which can process landfill waste to extract commodity recyclables and convert carbon-based materials into fuels. It can form an integral component in a system to achieve zero-waste and produce renewable fuels, whilst caring for the environment. Plasma arc processing has been used for years to treat hazardous waste, such as incinerator ash and chemical weapons, and convert them into non-hazardous slag.

Method/Procedure

Gasification takes place at very high temperatures, driven by the plasma torch system, which is located at the bottom of the gasifier vessel. The high operating temperatures break down the coal and/or all hazardous and toxic components into their elemental constituents, and dramatically increase the kinetics of the various reactions occurring in the gasification zone, converting all organic materials into hydrogen (H_2) and carbon monoxide (CO). Any residual materials of inorganics and heavy metals will be melted and produced as a vitrified slag which is highly resistant to leaching.

According to WPC's estimation, only 2 to 5% of the total energy input into their gasification system is consumed by the plasma torch, and that 80% of the total energy input in the feed can be recovered in the produced syngas.

They believe their technology can be demonstrated to gasify coal in an ambient pressure, plasma-fired reactor that can be retrofitted into existing power plants and/or installed as a new facility, with the following potential benefits over a pulverized coal power and/or conventional gasification plant:

- Greater feed flexibility enabling coal, coal fines, mining waste, lignite, and other opportunity fuels (e.g., biomass and MSW) to be used as fuel without the need for pulverizing
- Air blown and thus an oxygen plant is not required
- High availability (>90%)
- High conversion (>99%) organic matter to synthesis gas (syngas)
- No tar in syngas; syngas of approximately 140 Btu/scf for air-blown design suitable for syngas combustion turbine operation after gas clean-up
- No char, ash or residual carbon; only producing a glassy slag with beneficial value
- Compliant with EPA New Source emissions standards for nitrogen oxide (NOx), sulfur oxide (SOx) particulates, etc.
- Higher thermal efficiency
- Lower carbon dioxide (CO_2) emissions
- Low estimated capital and operations and maintenance (O&M) costs.

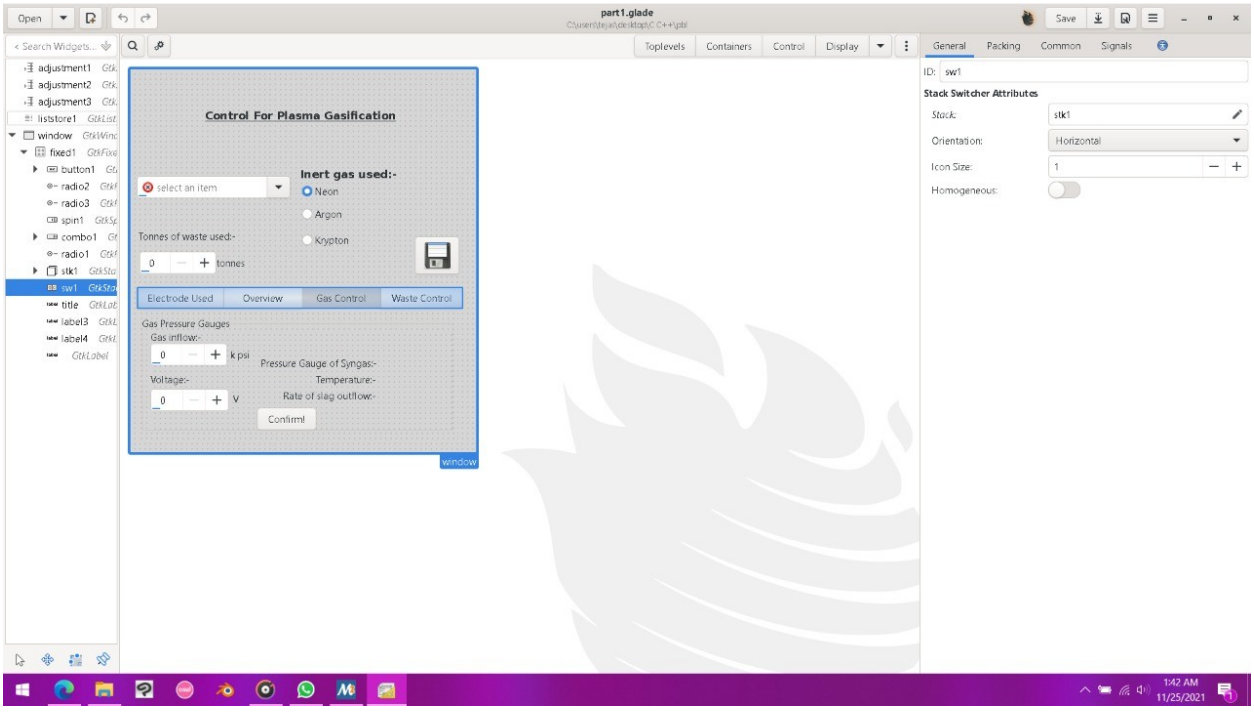
Proposed Model

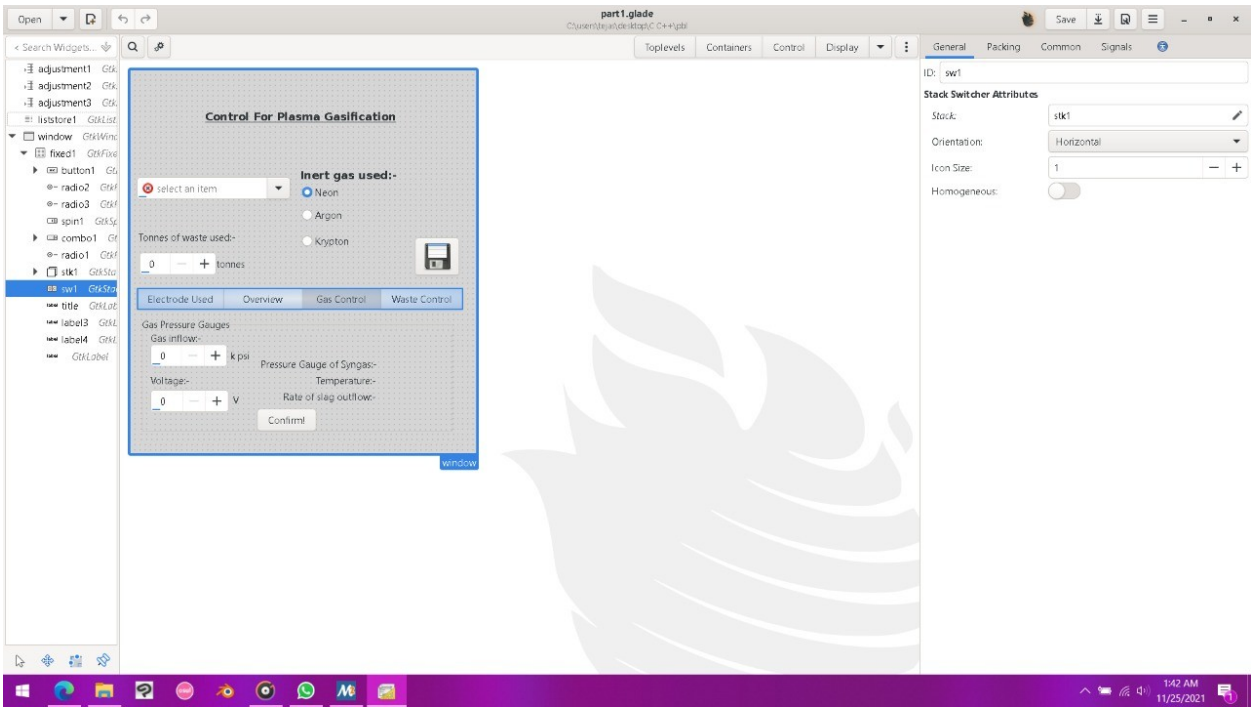
Glade is a RAD tool to enable quick & easy development of user interfaces for the GTK toolkit and the GNOME desktop environment. The user interfaces designed in Glade are saved as XML, and by using the GtkBuilder GTK object these can be loaded by applications dynamically as needed.

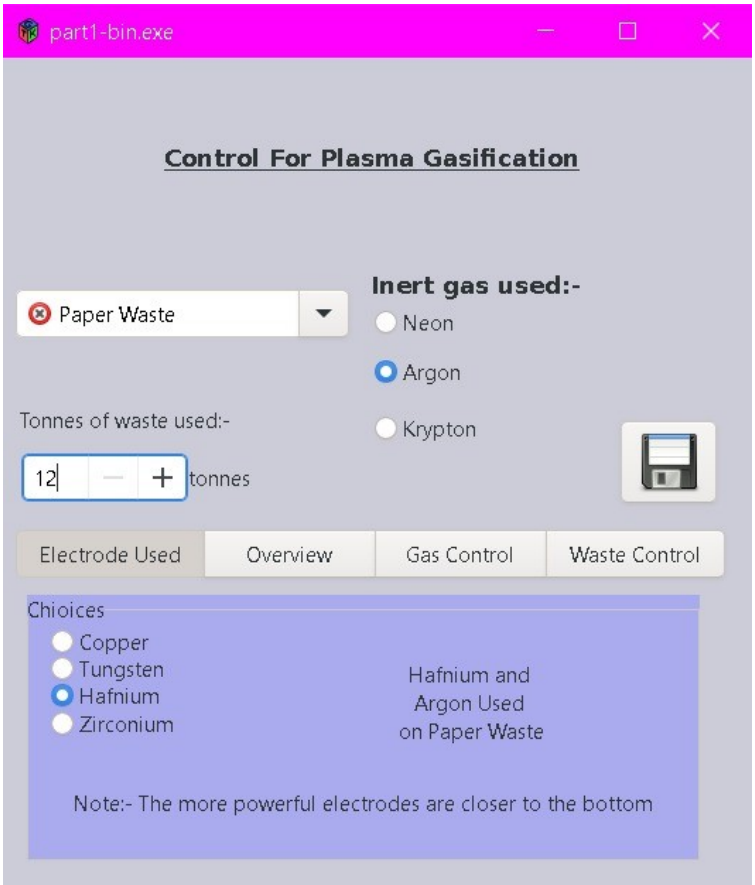
Code sketchers are software applications that help a user create source code from a GladeXML file. Most code sketchers create source code which uses libglade and a GladeXML file to create the GUI. Some sketchers can create raw code that does not need the GladeXML file. The table below compares basic information about GladeXML code sketcher packages.

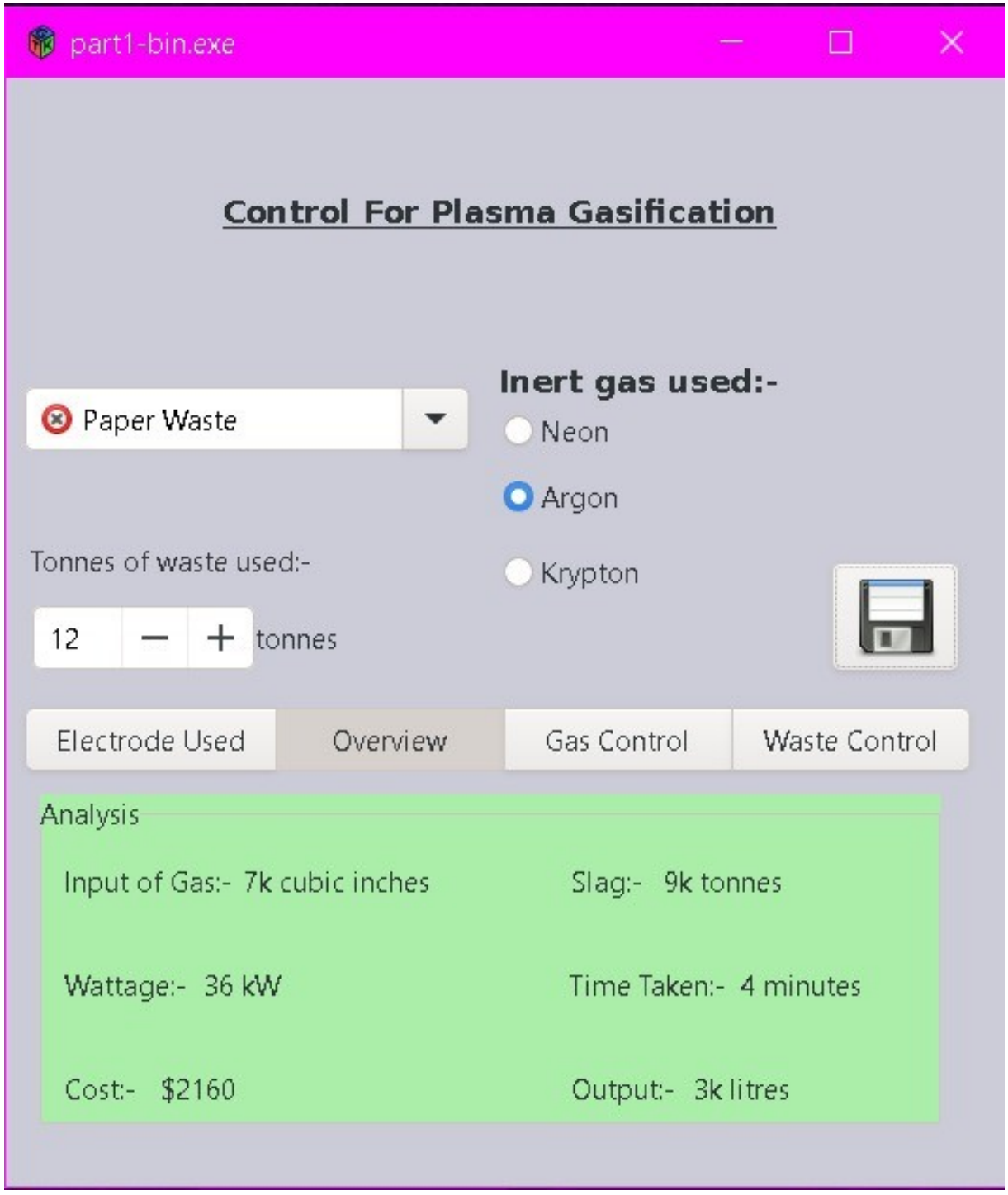
In this Project, Glade is Used for GUI of the program. The Entire Code i.e., The backend development is done using C Language. According to the research carried out for this project, The factors like Temperature required for Gasification is a top of 16000 Degrees Cel. Which Is unattainable at our stance.

Thus, In our Proposed Model of this project, We have used our Research Data to create something which closely resembles a real Plasma Gasification project.




part1.glade
Control For Plasma Gasification
Inert gas used:-
Neon
Argon
Krypton
Tonnes of waste used:-
tonnes
Electrode Used
Overview
Gas Control
Waste Control
Gas Pressure Gauges
Gas inflow:-
k psi
Pressure Gauge of Syngas:-
Voltage:-
Temperature:-
V
Rate of slag outflow:-
Confirm!
window


part1-bin.exe
Control For Plasma Gasification
Paper Waste
Inert gas used:-
Neon
Argon
Krypton
Tonnes of waste used:-
12
tonnes
Electrode Used
Overview
Gas Control
Waste Control
Chioices
Copper
Tungsten
Hafnium
Zirconium
Hafnium and
Argon Used
on Paper Waste
Note:- The more powerful electrodes are closer to the bottom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Krypton
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tonnes
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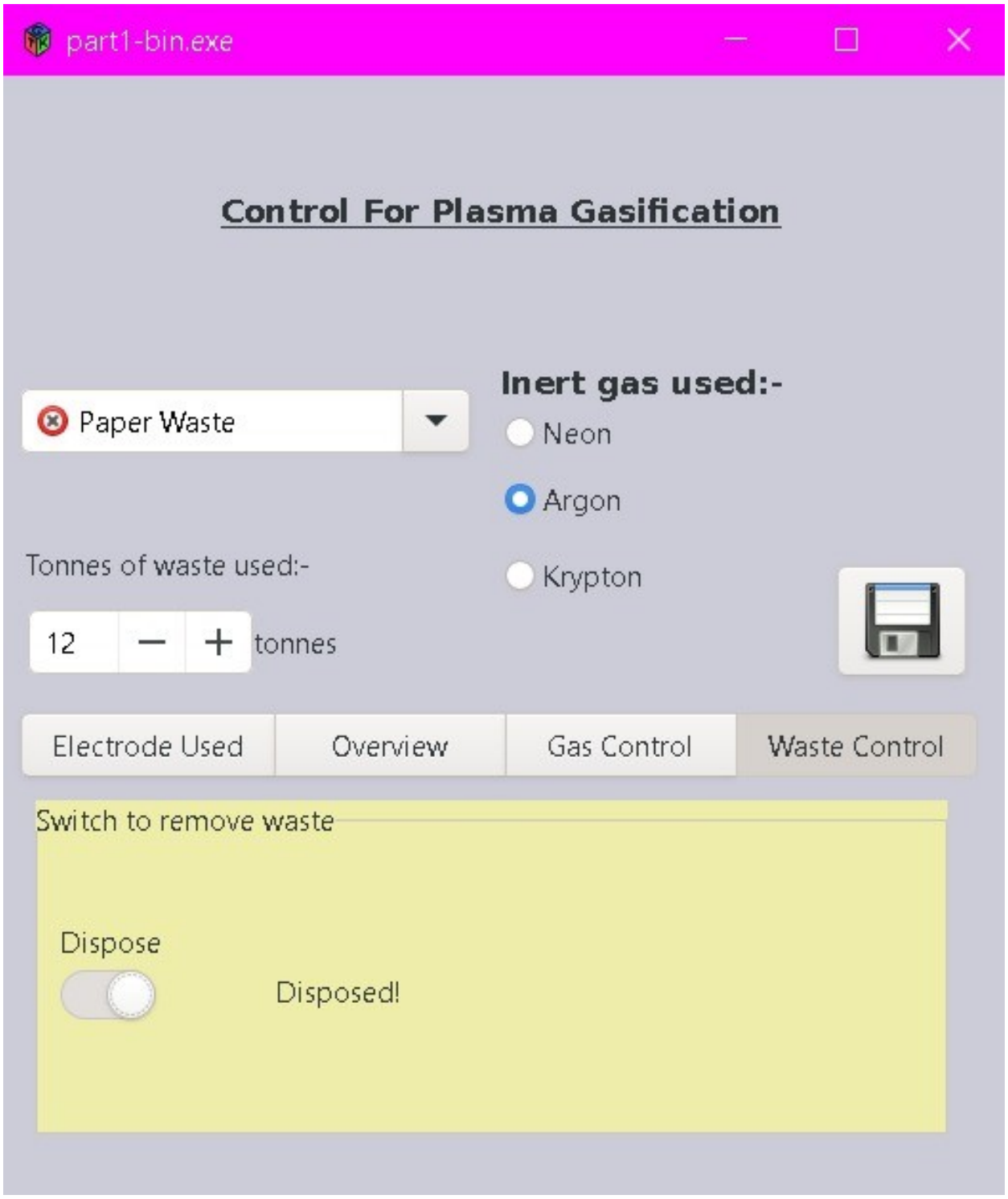
Overview
Gas Control
Waste Control
Analysis
Input of Gas:- 7k cubic inches
Slag:- 9k tonnes
Wattage:- 36 kW
Time Taken:- 4 minutes
Cost:- $2160
Output:- 3k litres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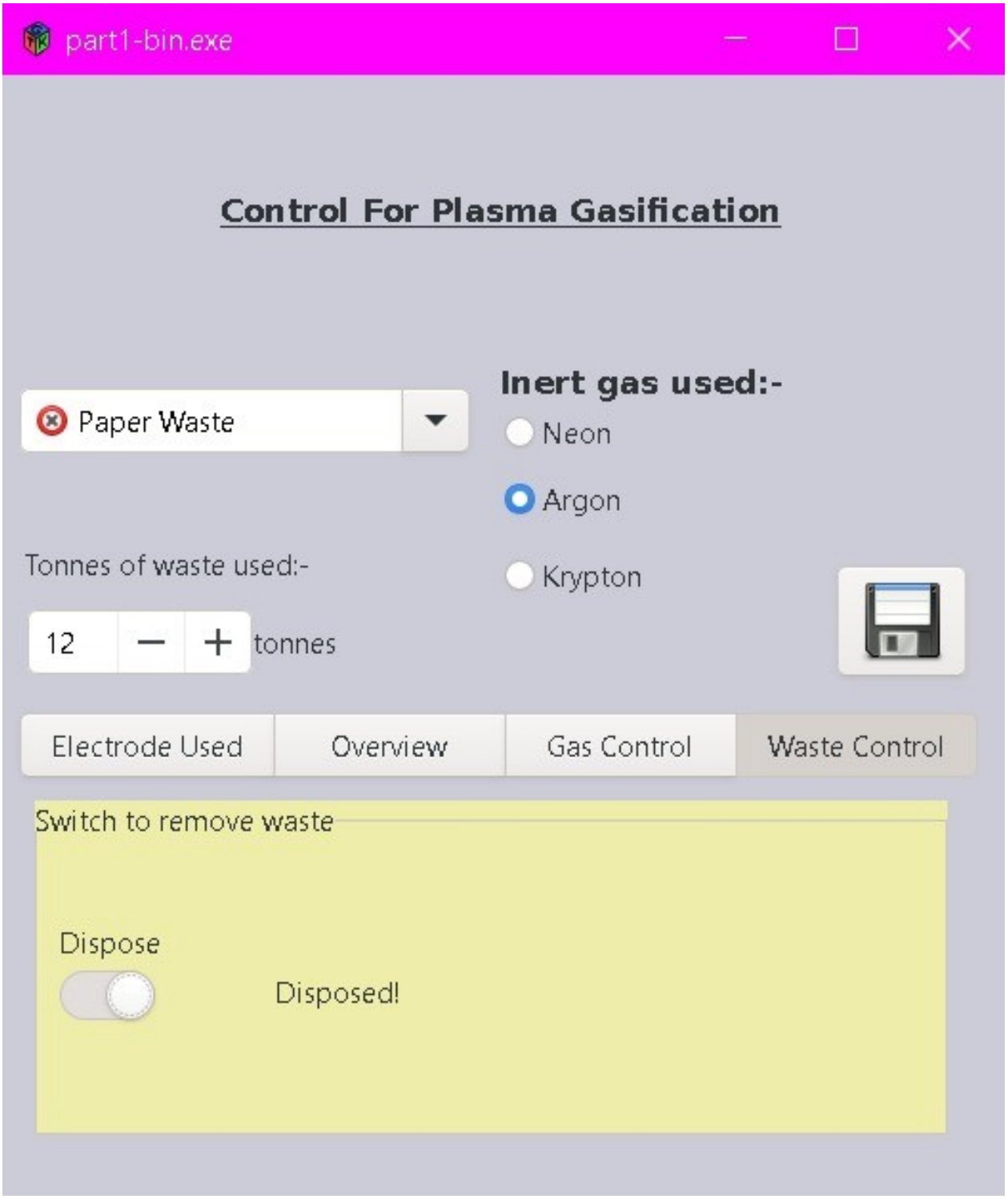
Overview
Gas Control
Waste Control
Switch to remove waste
Dispose
Disposed!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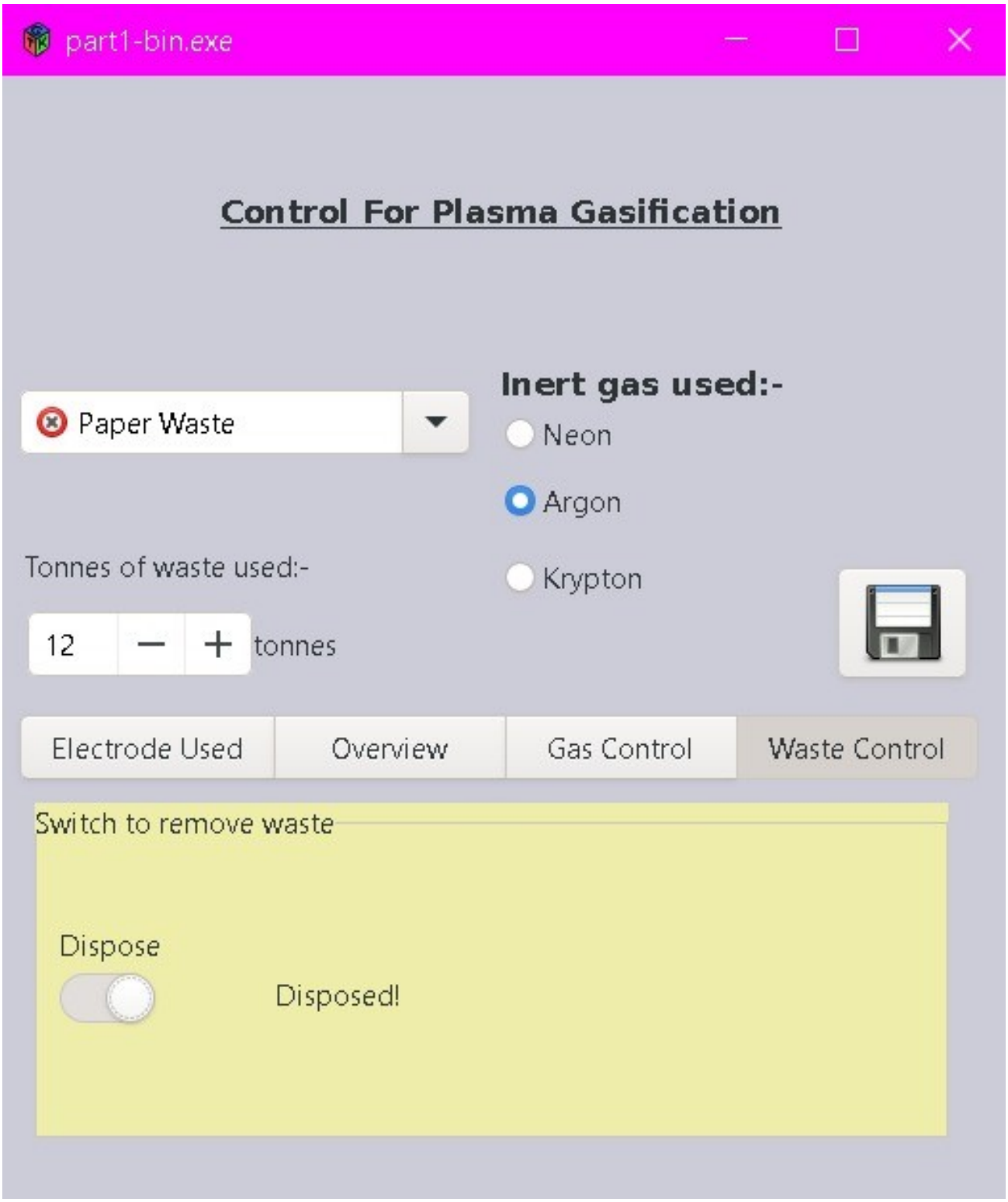
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Waste Control
Switch to remove waste
Dispose
Disposed!

In our Proposed Model, Whenever There is a change in the input Gas Pressure or the voltage. The Temperature label is bound to change. This is where the research has an impact over our Project.

Conclusion

This project was a huge learning experience for all four of us and learning about GTK was truly an interesting and curious venture for us. We are glad that we worked on this project, and hope that there are more opportunities like this where we can showcase our abilites!

REFERENCES

We thank all of these sources for the information that they provided that made this project possible.

The GTK Project - A free and open-source cross-platform widget toolkit

Glade - A User Interface Designer (gnome.org)

Using MSYS2 in CI - MSYS2

ACKNOWLEDGEMENT

With deep sense of gratitude we would like to thank all the people who have lit our path with their kind guidance. We are very grateful to these intellectuals who did their best to help during our project.

It is our proud privilege to express deep sense of gratitude to our Project Guide Jesalkumari Varolia for her continuous guidance and support throughout our project. It would never have been possible for us to complete this project successfully without her guidance and support.

We remain indebted to our H.O.D Dr. Rekha Sharma CMPN Department, Principal Dr. B.K. Mishra for their comments and kind permission to complete this project. We would also like to thank them for their timely suggestions and valuable guidance.

And lastly, we would like to thank our friends and the people who are directly or indirectly related to our project.