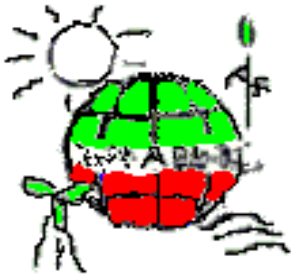
بسم الله الرحمن الرحيم



طاقة الشمال

North Lebanon Alternative Power

www.nlap-lb.com

Subject: Project Proposal

Project title: Al-Denniye 30 tons/day Waste incinerator

First Party: Muhammad Najib, رئيس بلدية عيات عكار

Second Party: NLAP Company

Authors: Samir Mourad, Hassan Zhairabany

Last update: 2/20/2018

Content

1 Introduction

This paper contains all the technical characteristics of the project and the costs needed to construction.

2 Background

Specification: 30 tons tons per 24 hours of houses wastes separated from the recycling materials such the Metals, Glass and Batteries… Absolutely the eliminate must be according to the international norm of emission and under the legal limits of pollution.

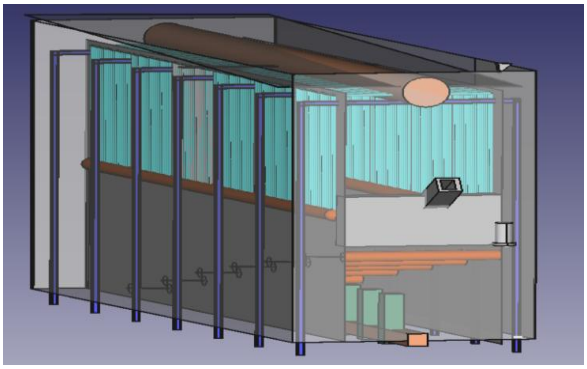
3 Project Overview

The station should comport this basic characteristics below:

- The station should eliminate to the end 30 tons as maximum quantity of treated Household waste per 24 hours.
- The station comport a filtration system to be respect the Lebanese-international norm of emission for the smoke. The filtration system is supported by LÜHR (Germany Company for manufacturer of filters)
- This norm is present in the Annex 3.
- The project comport, into the consideration, the treatment of the incineration remnants {Smoke and Asher}, to be used into other useful utilization.
- The Design of station should be able to generate the electricity or other useful type of power in the future upon the request.
- The project needs 4 months to be created after the approval and the availability of the financing

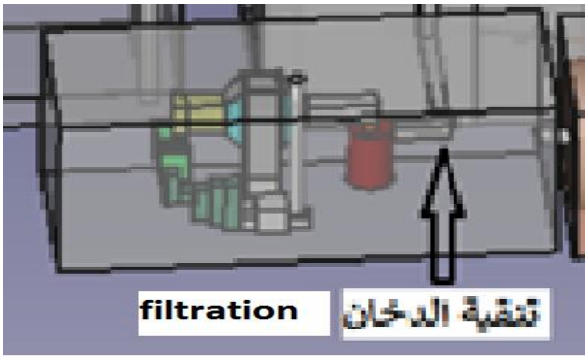
4 Project Design Parts

1. Storage waste area
2. Garbage with the Winch
3. Incinerator

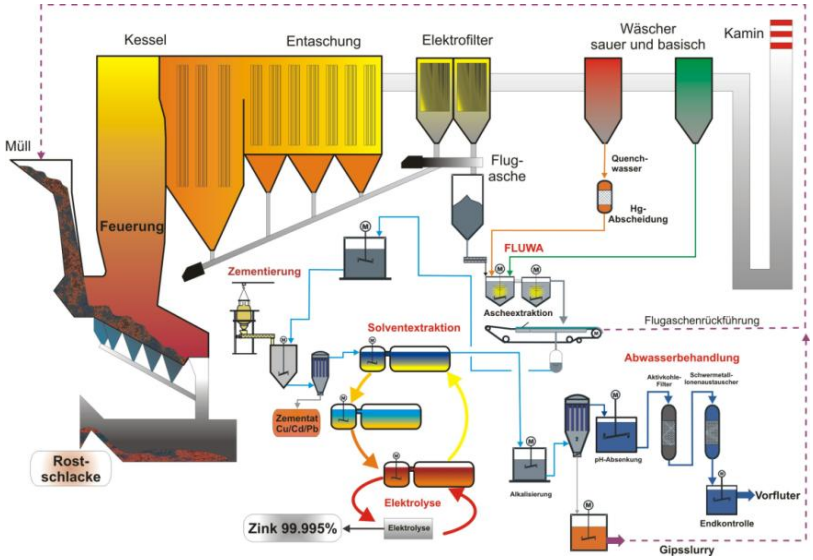


4. Water tank

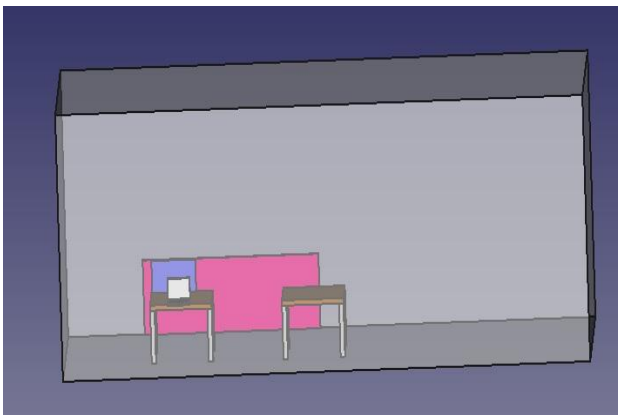
5. Smoke Filtration System



This figure below show a schematic of the Smoke filtration residuals recycling system



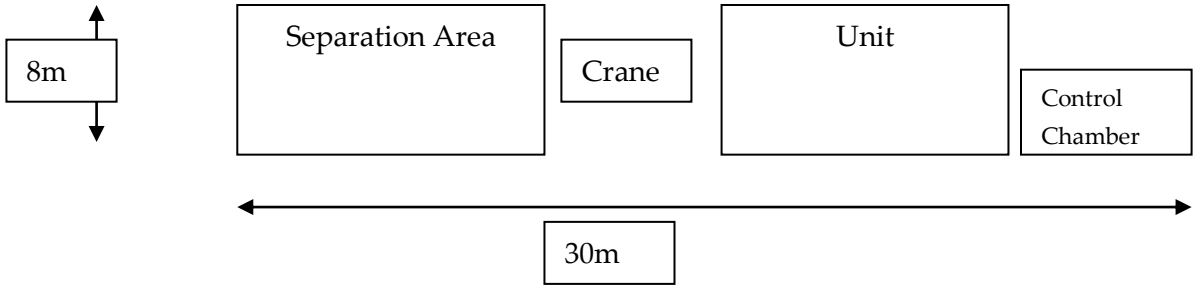
6. Control Chamber



7. System treatment for the Ash after the incineration

5 Project Schematics

The project needs a land surface show in the figure below



6 Detailed Project Function Description

6.1 Conditions and how to bring the waste

Firstly we need to separate the waste before the incineration if the waste isn't separated, the best case is the separation from the source, and we have two type of this case:

Individual separation: the waste must be separated in two containers one for the waste like (plastics, glass, papers, metals), and the other for the organic waste. This type is simple and possible to achieve it for everyone.

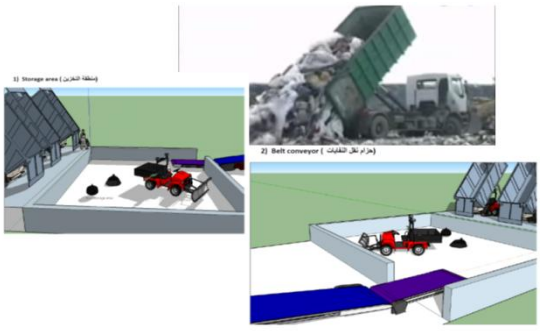
Multi separation: in this case each type of waste must be separated into a container, so we need a container for the paper, and other one for the plastics, etc… this type is difficult to achieve it need consciousness and great response from the citizens and need several containers…

The waste must be bringing into a storage region, have autonomy of 2 days, 200 m3 of waste, and the deep of the storage is 1.5 m, so the land surface needed is approximately 12*10 meters = 120 m2

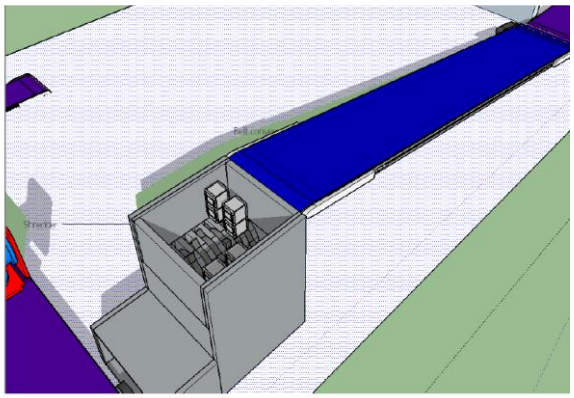
Critical substances should not be burned so as not to produce toxic smoke requiring costly treatment, like PVC and batteries

The figure below descript how should be the view of this part

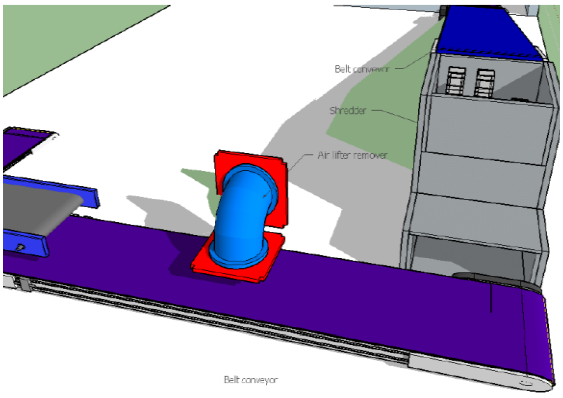
1. Storage and belt Conveyor



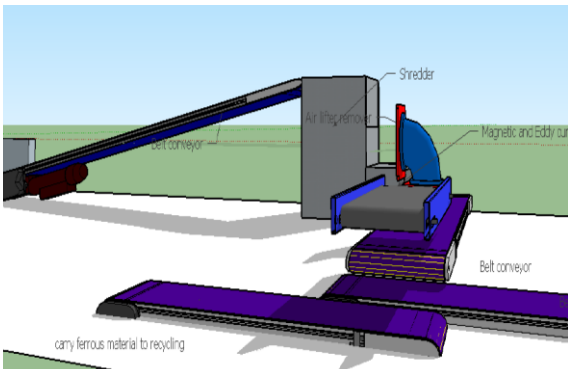
2. Shredder (machine how cut the waste)



3. Air filter remover



4. Iron separation system using the magnetic power



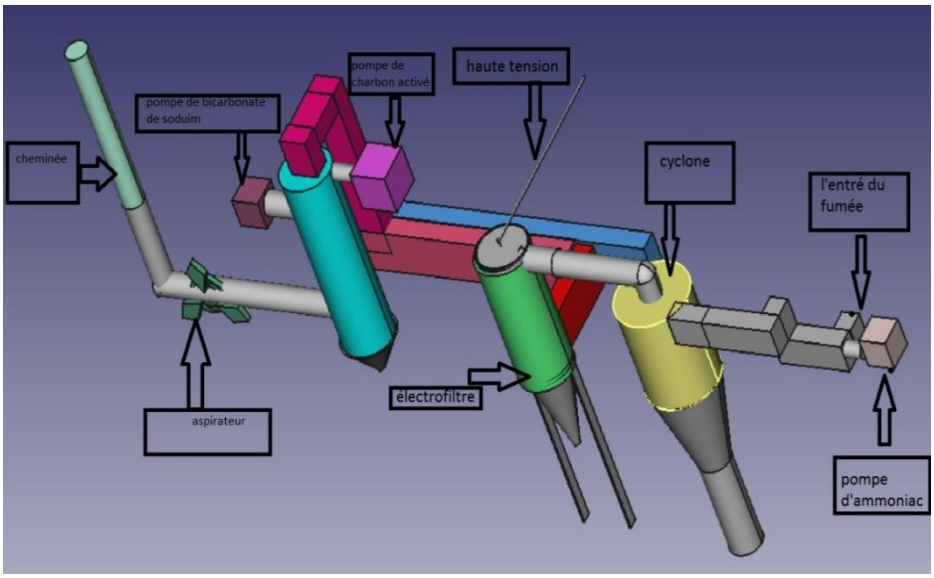
Now we can start by the incineration.

6.2 Smoke from burning and purifying household waste before leaving the station

After the burning, we can divide the emissions into three groups with their dangerous, the description present into the Annex 1.

These gases are processed through an integrated multi-flattening system. Our system is composed of smoke purifier treatment:

1. Cyclone
2. Electric Filter
3. Bicarbonates Sodium Pumping System
4. Active Coal Pumping System
5. Chimney



The roles of each part:

• An electric filter to separate solid particles such as dust from gases is effective, especially on molecules with large dimensions.

• The second step is gas cooling of the water to increase the effectiveness of sodium bicarbonate.

• Sodium bicarbonate is the basis that neutralizes acid gases

• Activated charcoal absorbs dioxin and furan.

6.2.1 Volume of Smoke Produce and limits of emissions

We work in the most compelling cases:

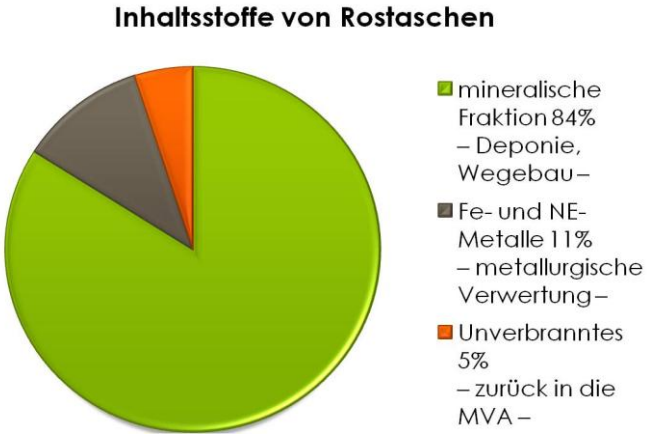
Actual capacity furnaces processing is 150 t/day

It is considered that the plant operates all year round; the ovens are interrupted seven days per year for maintenance. Thus, each furnace is operated 358 days per year.

In our cases and according to the Master thesis Maya kamardin* page 55 and 99, each kg of waste produce 7.47 Nm^3 of wet smoke, According to the result in the master thesis, the dust's mass equal 170 mg/m^3 < 200 mg/m^3 , Positive result.

6.3 Ash Treatment

The Ash contains three major parts shown in the figure below



84% menials; 10% iron, copper and Aluminum; 5% part not burning but it is Burnable so should be return to the incinerator.

7 Business Plan 2017-2018 for project "Manufacturing and operation of 30tons/day incineration plant"

7.1 Project cost

Incinerator for 30 tons of waste per day, total installation costs				
Material Costs (including workers for manufatoring)				
Part	Number of pieces	Description	Total	
Separtion waste system	2		$ 70.000,00	
Winch for separated waste	1		$ 100.000,00	
Pipining tubes (Stainless)			$ 45.000,00	
diesel burner including fuel feed	1		$ 2.000,00	
safety valve 15 bar	1		$ 1.000,00	
pressure sensor	5		$ 15.000,00	
fresh water tank (stainless)	1		$ 2.000,00	
incineration burning chamber (including transportation band)&vaporizer (climbing tubes…)	1		$ 200.000,00	
Smoke Filtration including the (Electrlic filter, Bicarbonates system, Active Coal sytem, Bag filter, Chimney)	1		$ 150.000,00	Installation Cost $71.500
Hardware Control System (Including Instrumentation)	1		$ 50.000,00	Total Plant
Mobile blatform	1		$ 30.000,00	$786.500
Remains smoke treatment (FLUWA/FLUREC)	1		$ 30.000,00	**x 1.3 (with overhead)**
Bottom ash treatment			$ 20.000,00	**$1.022.450**
Total Material			**$715.000**	
Operation Cost				
Task	Number	Qualifikation	Salary/month	Total Salary/yea
Forman	1	Forman expert	$1.000	$ 12.000,00
Winch employee	1	Winch expert	$1.000	$ 12.000,00
Control system employee	1	Eng expert	$1.000	$ 12.000,00
			$1.000	$ -
Waste Separation empolyee	2	Empolyer	$600	$ 14.400,00
master students, Practicants	2	Professional master		$ -
Maintenance Plant			$35.000	
Total Operation Cost per Year	**7**			**$85.400**

7.1.1 Funding utilization and milestones

		Milestone		Funding need
2018	كانون الثاني			
	شباط	Ground for production facility ready	Infrastructure	
	آدار	NLAP production plant at Ras Nhache site installed (Hangar)	Infrastructure	
	نيسان	Ground for 1.5 MW is aquisited and prepared Detailed Specification &Design according to customers wish finished	Incinerator plant project	
	أيار	Start of manufacturing &installation	Incinerator plant project	
	حزيران	Manufacturing of Incinerator & Vaporizer finished	Incinerator plant project	
	تموز	Smoke filtration System	Incinerator plant project	
	آب	Process control system installed and tested & wohle plant integration tested	Incinerator plant project	
2018	أيلول	Delivery of plant	Incinerator plant project	

7.2 Hydrogen Production Cost by electrolysis of water

7.2.1 Production estimation

In our case we have a maximum capacity of waste approximately 30 tons/day this produce 2 MW during 12 hours so 24 MWh/day. We need to estimate the **quantity of the hydrogen** can be produced by this energy each day. 10 kg of H_2 needs 6 MWh of electrical energy, so we need a turbine and generator of electricity, Hydrogen Generation Cost table:

Part	**Quantity**	**Price**	**Total by $**
Water antioxidant system	1	$25.000	$25.000
Turbine System	1	$1.000.000	$1.000.000
Generator	1	$32.500	$32.500
Condenser	1	$35.000	$35.000
Condenser cooling	1	$2.500	$2.500
Converter	1	$40.000	$40.000
Electrolysis system	800 €/kW, for 2 MW	200,00 €	$250.000
Total cost hydrogen generation system			$1.385.000
Total Cost with the incinerator project			$2.385.000

7.3 Financial return

	H2 Production
Daily quantity	40 kg
Annual quantity	15,000 kg
Market price per kg	10 $/kg
Total income per year	150,000$

Operation Cost: 85,000$ per year

-> Win each year: 65,000 $

Payback Time = Cost on the life time / Money back each year: ... years

8 Annexes

8.1 Annex 1: the smoke type produce after the burning

- الغازات الغير ضارة للبيئة: النتروجين (N2), ثاني اكسيد الكربون(CO2), الاكسيجين(O2),وبخار المياه(H2O)
- الغازات الحمضية (مضر للبيئة لانها تسبب امطار حمضية): ثاني اوكسيد النتروجين(NO2),اكسيد النتروجين (NO),ثاني اوكسيد السوفر(SO2)
- الغازات السامة: الفوران Furanes, الديوكسين dioxines , المعادن الثقيلة((from batteries) heavy metals (Hg

غير ان 95% تقريبا من هذه الغازات هي من المجموعة الاولى اي غيرمضرة للبيئة وغير سامة

تتاثر مكونات ونسبتها من الغازات بحرارة الحرق وبكمية الاكسيجين(O2), فمثلا على حرارة درجة 850 ℃ وكمية الاكسيجين 6% من الهواء وهذه من اسؤ الحالات وهذه الحالة تعطينا:

ثاني اكسيد الكربون(CO2) بين $186\ ^{mg}/_{m^{-3}}$ و $96^{mg}/_{m^{-3}}$.

ثاني اوكسيد النتروجين (NO2)بين $320\ ^{mg}/_{m^{-3}}$ و $140\ ^{mg}/_{m^{-3}}$

الفوران Furanes, الديوكسين dioxines , بين $21\ ^{mg}/_{m^{-3}}$ و. $5\ ^{mg}/_{m^{-3}}$.

اوكسيد السوفر(SO2) $67\ ^{mg}/_{m^{-3}}$

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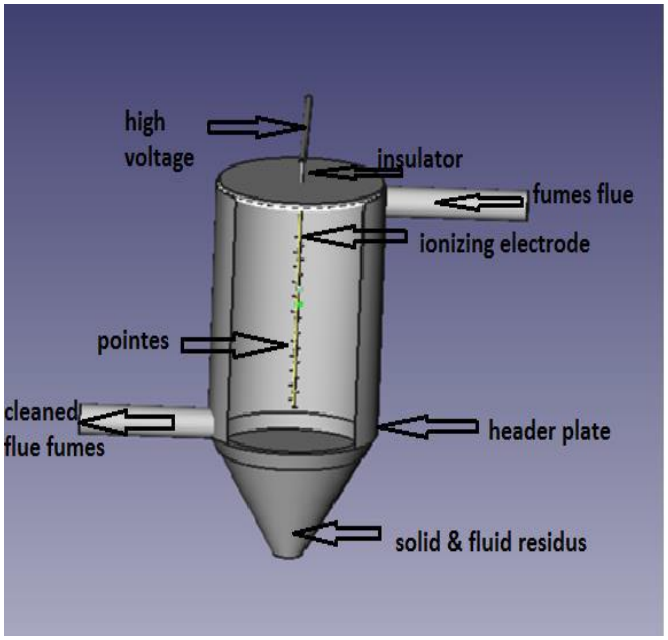
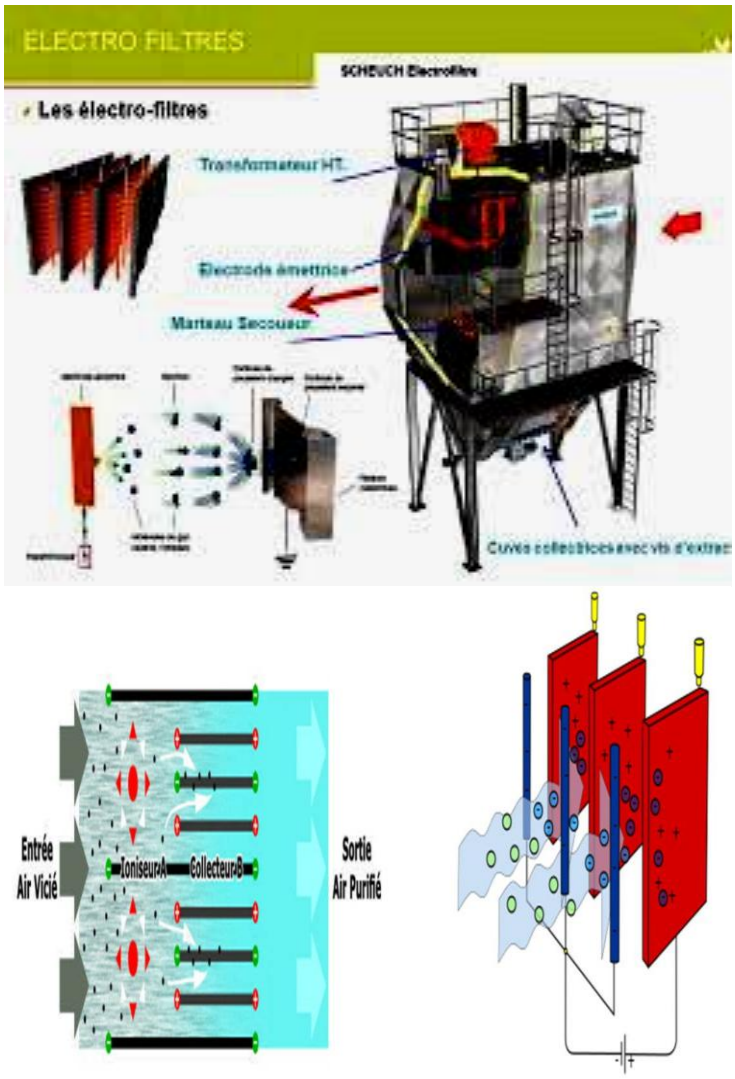
8.2 Annex 2: the filtration system parts

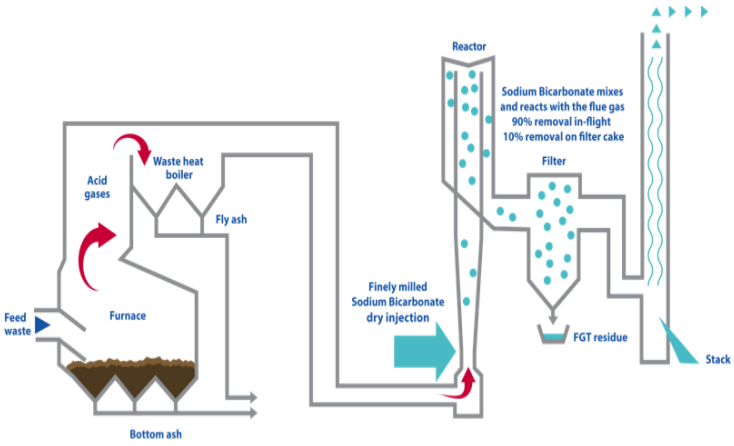
Cyclone



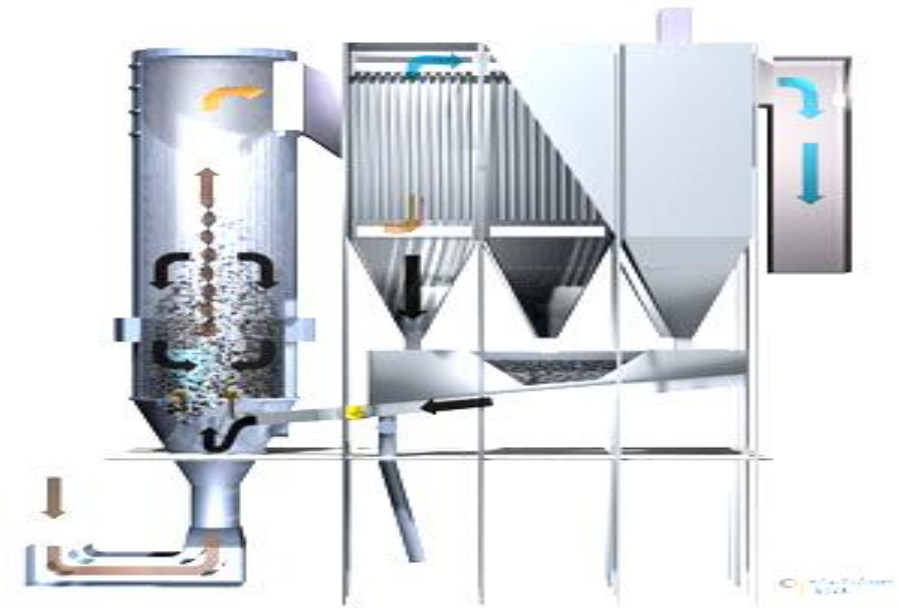
Electrostatic filter



Bicarbonat sodium pumping system



Active coal pumping system



8.3 Annex 3: Lebanese- international Norm of smoke Emission

Valeurs limites à respecter lors de l'incinération des ordures ménagères
الحدود القصوى المسموح بها لملوثات الهواء في الانبعاثات الناجمة
عن حرق النفايات المنزلية

Capacité de l'incinérateur
طاقة الاستيعاب

>3 tonnes /H اكثر من ٣طنان/ساعة		1-3tonnes/H من١-٣ طن في الساعة		<1 tonne/H اقل من طن في الساعة			
Valeur maximale mg/m3	الحدود القصوى ملغ/ متر مكعب	Valeur maximale mg/m3	الحدود القصوى ملغ/ متر مكعب	Valeur maximale mg/m3	الحدود القصوى ملغ/ متر مكعب	Element	الملوث
30	٣٠	100	١٠٠	200	٢٠٠	Poussières totales	الجسيمات العالقة الكلية
5	٥	5	٥	-	-	Pb+Cr+Cu +Mn	رصاص+كروم+ نحاس+مانغانيز
1	١	1	١	-	-	Ni+As	نيكل+زرنيخ
0,2	٠،٢	0,2	٠،٢	-	-	Cd+Hg	كادميوم وزئبق
50	٥٠	100	١٠٠	250	٢٥٠	Cl en HCl	كلور (كحامض هيدروكلوريك)
2	٢	4	٤	-	-	F en HF	الفلور (كحامض هيدروفلوريك)
300	٣٠٠	300	٣٠٠	-	-	SO_2	ثاني اكسيد الكبريت

Zevenhoven & Kilpinen *FLUE GASES and FUEL GASES* *19.6.2001* *2-4*

Typical compositions of some raw flue gases and fuel gases i.e. before gas clean-up
(data from Alderliesten et al., 1990, Gasunie, 1988, Göttlicher, 1999, Maskuniitty, 1995, Werther, 1999)

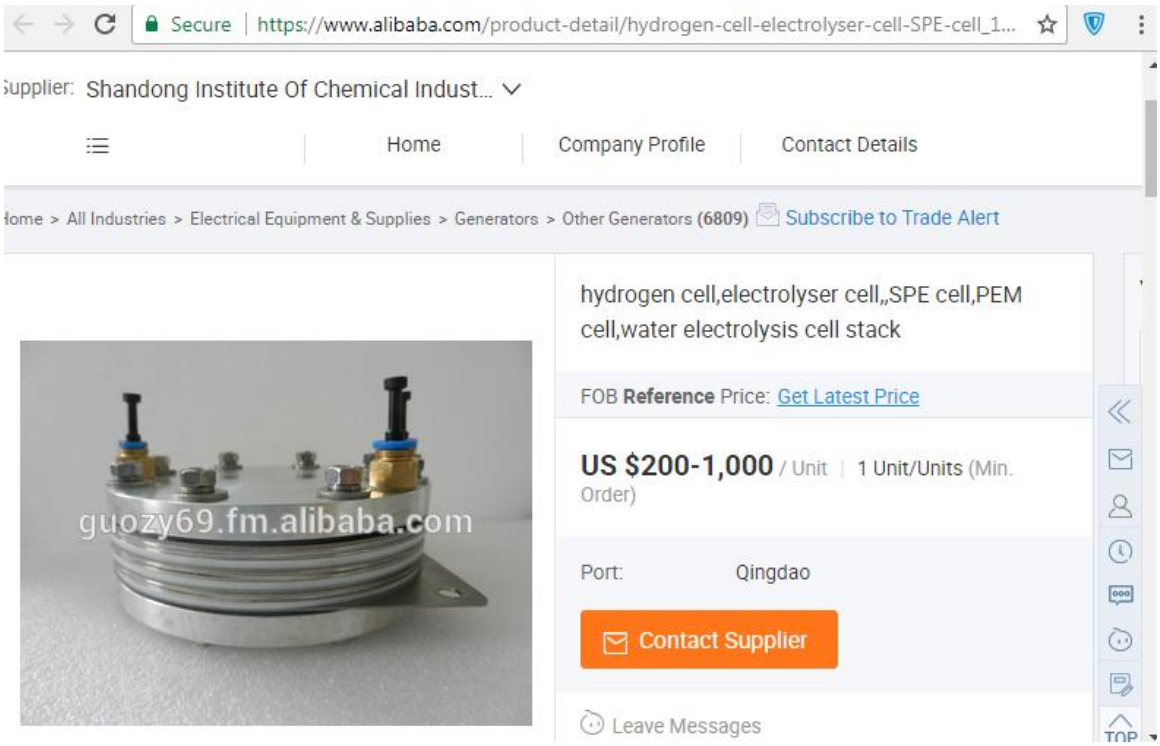
	Pulv. coal combustion flue gas	Waste incinerat. flue gas	Coal gasification fuel gas §	Coal-fired IGCC flue gas	Natural gas Groningen	Gas-fired CC flue gas
O_2 %-v	~ 6	7 - 14		~ 12		~14
N_2 %-v	~ 76	balance	~4 / ~1	~ 66	~14	~76
CO_2 %-v	~11	6 - 12	~4 / ~13	~ 7	~1	~ 3
H_2O %-v	~ 6	10 - 18	~4 / ~1	~ 14		~ 6
CO %-v		0.001-0.06	~58/~40			
H_2 %-v			~30/~29			
Ar %-v	~ 1	~ 1	~ 1	~ 1		~1
SO_2 ppmw		200 -1500		10 - 200		
H_2S ppmw			1000-4000			
NOx ppmw	500 - 800	200 - 500		10 - 100		10 - 300
NH_3 ppmw			300 - 800			
HCN ppmw			40 - 150			
HCl ppmw		400 - 3000	500 - 600			
HF ppmw		2 - 100	150 - 250			
dioxine ppb	<< 1	1 - 10				
CH_4 %-v					~ 81	
C_nH_m %-v		< 0.002			~ 4	
Hg ppmw	0.1 - 1	0.1 - 1	0.01 - 0.1			
Cd ppmw	0.01 - 1	0.1 - 0.5	0.01 - 0.2			
other heavy metal ppmw	0.5 - 2	1 - 5	~ 20			
dust g/m³	5 - 20	0.2 - 15	~17 / ~8	<< 0.02		

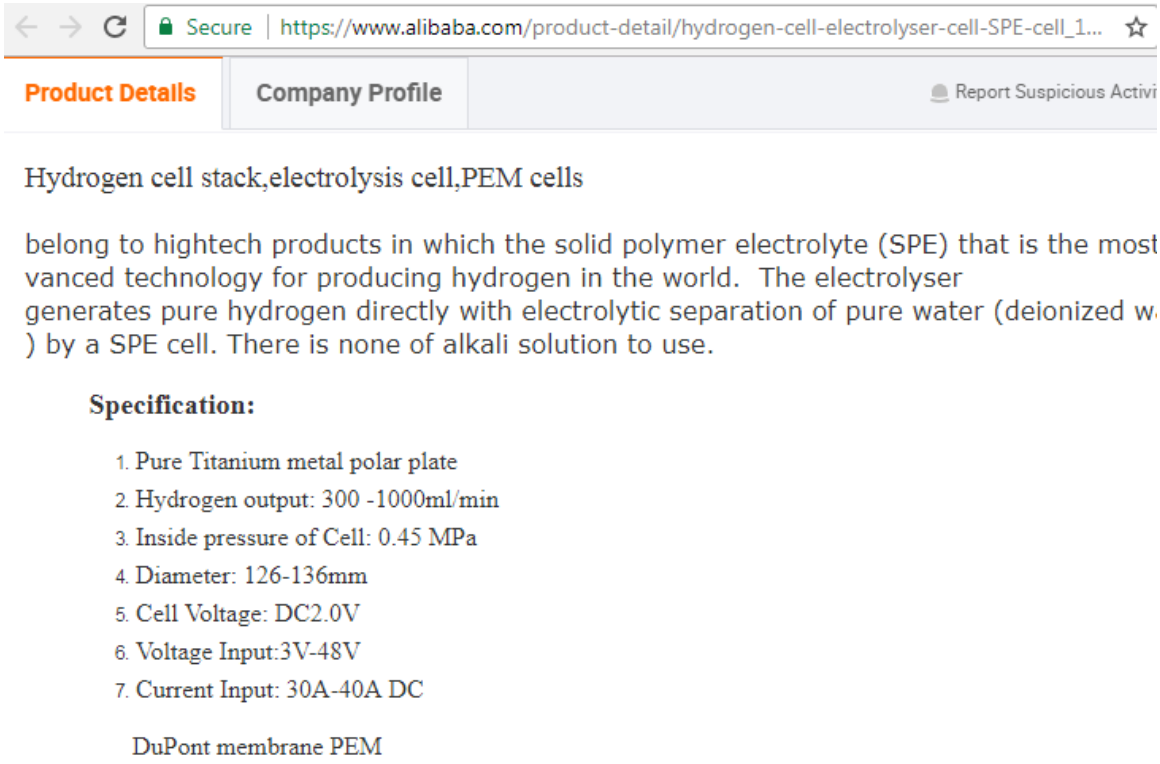
8.4 Annex 4: Electrolysis machine

Main Technical Data - SILYZER 200

Electrolysis type / principle	PEM
Rated Stack Power	1.25 MW
Dimension Skid	6,3 x 3,1 x 3,0 m
Start up time (from stand-by)	< 10 sec
Output pressure	Up to 35 bar
Purity H_2 (depends on operation)	99.5% - 99.9%
H_2 Quality 5.0	DeOxo-Dryer option
Rated H_2 production	225 Nm³/h
Overall Efficiency (system)	65 – 70 %
Design Life Time	> 80.000 h
Weight per Skid	17 t
CE-Conformity	yes
Tap Water Requirement	1,5 l / Nm³ H_2

8.5 Annex 5: Electrolysis cost





https://www.alibaba.com/product-detail/hydrogen-cell-electrolyser-cell-SPE-cell_11262735.html?spm=a2700.7724838.2017115.11.1e94b09aky2NnV

(Price 200 - 1000 $)

8.6 Annex 6: Suppliers list with concrete offer

1 - Filter from

LÜHR FILTER GmbH & Co. KG

Enzer Str. 26 Tel.: +49 (0)5721 708-200

31655 Stadthagen Fax: +49 (0)5721 708-233200

DEUTSCHLAND E-mail: R.Margraf@luehr-filter.de

2 - Beth Filter GmbH, Germany - http://www.beth-filter.de – One of the most experienced European filter manufacturer

Main products are: Bag Filters, Dry/Wet Electrostatic Precipitators, Oil mist ESP, Tar ESP

3 - BG Filtration GmbH, Germany - http://www.bg-filtration.de/ - Manufacturer of various small filters

Main products are: Silo top filter, Oil mist Separator, Drum Filter for nonwoven/Chemicals/Textile/ /Cement/Food industry

4 – Electrolyze system- SILYZER PEM electrolyzer from Siemens Company

https://www.siemens.com/hydrogen-electrolyzer

6 - Omar M. Mohamad +961.81302512

8.7 Annex 7: Preliminary Meeting

8.7.1 Meeting with Rais Baladiyyat 'Ayyat (Akkar) Muhammad Najib (4.5.17) at House of Jamaluddin Mourad/Ras Nhache

Phase 1:

- فرز نفايات
- Incinerator
- Flue Gas Purification

Costs (offiziell angegeben): 50k$+200k$+50k$ = 300k$

Phase 2:

- تكملة 2 ميكاوات توليد كهرباء

There was already a meeting about 2 weeks ago. 2 MW plant, 3 Mio$

نتيجة: لعدم امكانية استخدام شبكة الكهرباء لشركة الدولة ولعدم السماح ببيع الكهرباء توقف المشروع.

8.8 Annex 8: METALS RECOVERY FROM BOTTOM ASH

Bottom ash is the main residue, in quantitative terms, of MSW incineration. Its production depends on the **inert content** of incinerated waste and on the type of **furnace technology** and bottom **ash extraction system**.

These treatments include **physical, chemical** or **thermal** processes.

Al_2O_3	CaO	Fe_2O_3	K_2O	MgO	MnO	N_2O	P_2O_5	SiO_2
8.66± 6.25	17.68± 15.37	8.68± 2.84	1.08± 0.78	2.52± 2.10	0.12± 0.08	4.73± 2.84	1.26± 0.88	48.40± 41.13

Metal ($\mu g\ g^{-1}$)	As	Cd	Cr	Hg	Ni	Pb	Sb	Zn
	1.4-114	0.25-11	0.5-1800	0.06-0.9	28-800	194-5000	10-147.5	300-8890

Physical separation

- Size classification is a fundamental step in this part
- Dry separation operates with standard drums or flat deck screens with a typical mesh size of 20-50 mm and 2-10 mm Or Wet separation can be performed through dense medium separation or attrition washing

- Ferrous and non-ferrous metals are present in the bottom ash in a range of 7-15% and 1-2%, respectively
- The recovery rates of ferrous and non-ferrous metals from the bottom ash is equal to about 60-80% and 25-35% of their amount in the waste, respectively.
- Ferrous and non-ferrous scraps can be separated from the bottom ash by using magnets and eddy-current separators.

Chemical separation

- To remove salts and heavy metals.
- Washing with water
- Allows to remove the soluble components like chloride, sodium and sulphate
- Sulfate separation: To improve sulphate solubilisation, NaHCO3 or CO2 can be used in the washing solution, improving the precipitation of Ca as carbonate in place of sulphate forms

Chemical stabilization

- The aim is to promote the formation of low solubility minerals, thermodynamically and geochemically stable.
- Reducing the leaching phenomena during the ash recovery or disposal.
- A first stabilization can be performed through the natural weathering.

[1] The main weathering reactions are:

- Carbonation: CO_2 (gas) + $Ca(OH)_2$ → $CaCO_3 + H_2O$ (Eq. 2.1)
- Sulphate destabilization: $CaSO_4 \rightarrow Ca^{2+} + SO_4^{2-}$ (Eq. 2.2)

$CaSO_4{*}H_2O \rightarrow Ca^{2+} + SO_4^{2-} + H_2O$ (Eq. 2.3)

- Formation of hydrocalcite ($Ca_2Al(OH)_6[Clx(OH)x]{*}3H_2O$) (Eq. 2.4)
- Formation of ettringite ($Ca_6A_l(SO_4)_{3(}OH)_{12}{*}26H_2O$) (Eq. 2.5)

- In the first case, the time needed to stabilize the ash is in the order of about one month

Thermal Separation

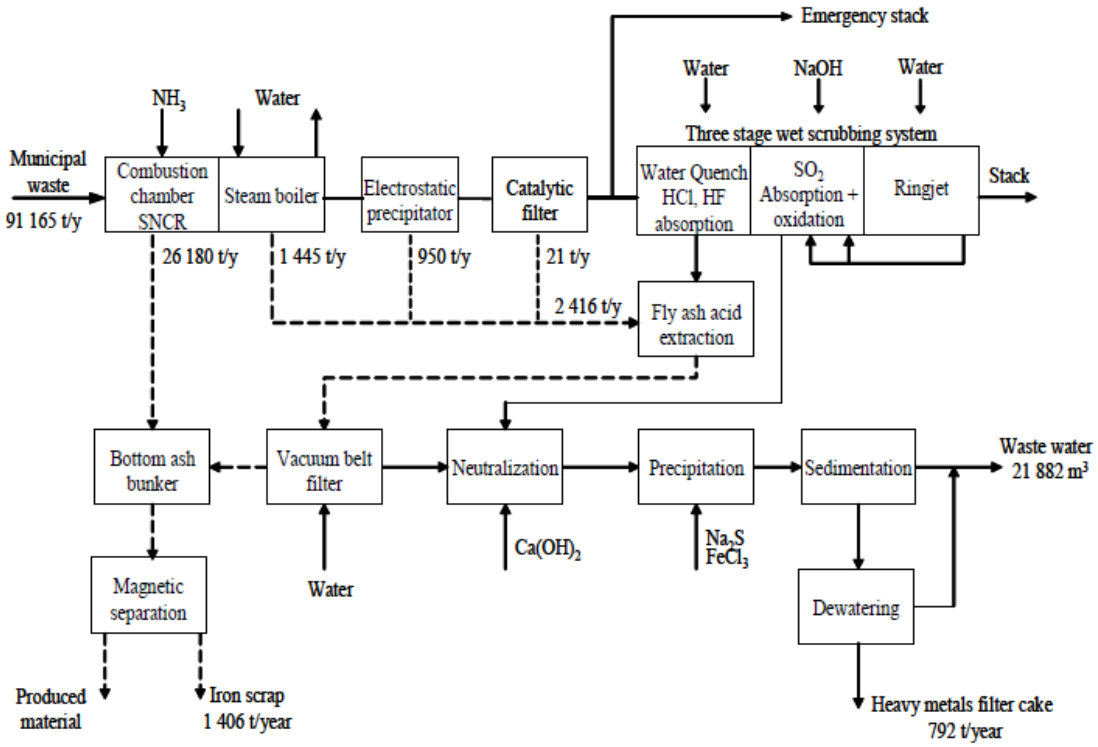
- Sintering and vitrification.
- Their aim is to reduce the volume of the residues and to improve their characteristics in term of mechanical strength, porosity, water adsorption, chemical stability and leaching of contaminants.
- Vitrification is performed at 1000-1500°C; the bottom ash is melted and a homogenous liquid phase is generated, which is rapidly cooled producing an amorphous glassy phase.
- Sintering is conducted at a temperature of about 900°C, below the melting point of the main bottom ash constituents.

Note: The high energy consumption and thus the high costs have limited the applicability of these technologies in Europe. However, the vitrification and the sintering of the bottom ash can be achieved contextually to the waste treatment in other waste-to-energy technologies than incineration, like in gasification and in pyrolysis, reducing the overall costs of waste and bottom ash treatment.

Heavy metal Quantity estimation (Pb, Cd and Sb)

TABLE 12
The reference of amount of Pb, Cd and Sb in household waste

	The amount estimated from the behavior (g/t)	The amount estimated from the origin (g/t)	Ratio (origin/behavior)
Pb	121.6	76.66	63%
Cd	3.45	2.94	85%
Sb	9.53	7.61	80%



From **[Šyc 2010]**

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