

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

محطة طاقة كهربائية عن طريق حرق النفايات بحجم

**1.5 MW**

المواصفات الفنية

**NLAP 1.5 MW Incineration Power Plant**

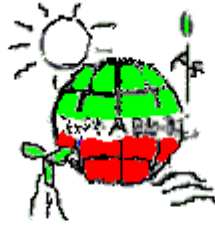
**Technical Specification**

Authors:

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Last update: 19-Dec-16



طاقة الشمال

**North Lebanon Alternative Power**

[www.nlap-lb.com](http://www.nlap-lb.com)

Name of document: D:\NLAP\Projects\1.5MW\_MobilePowerPlant\Design\_Spec\15-12-16NLAP-1.5MW\_IncinerationPlant\_TechnicalSpecification.docx

Responsible for Document: Malak Zoebi

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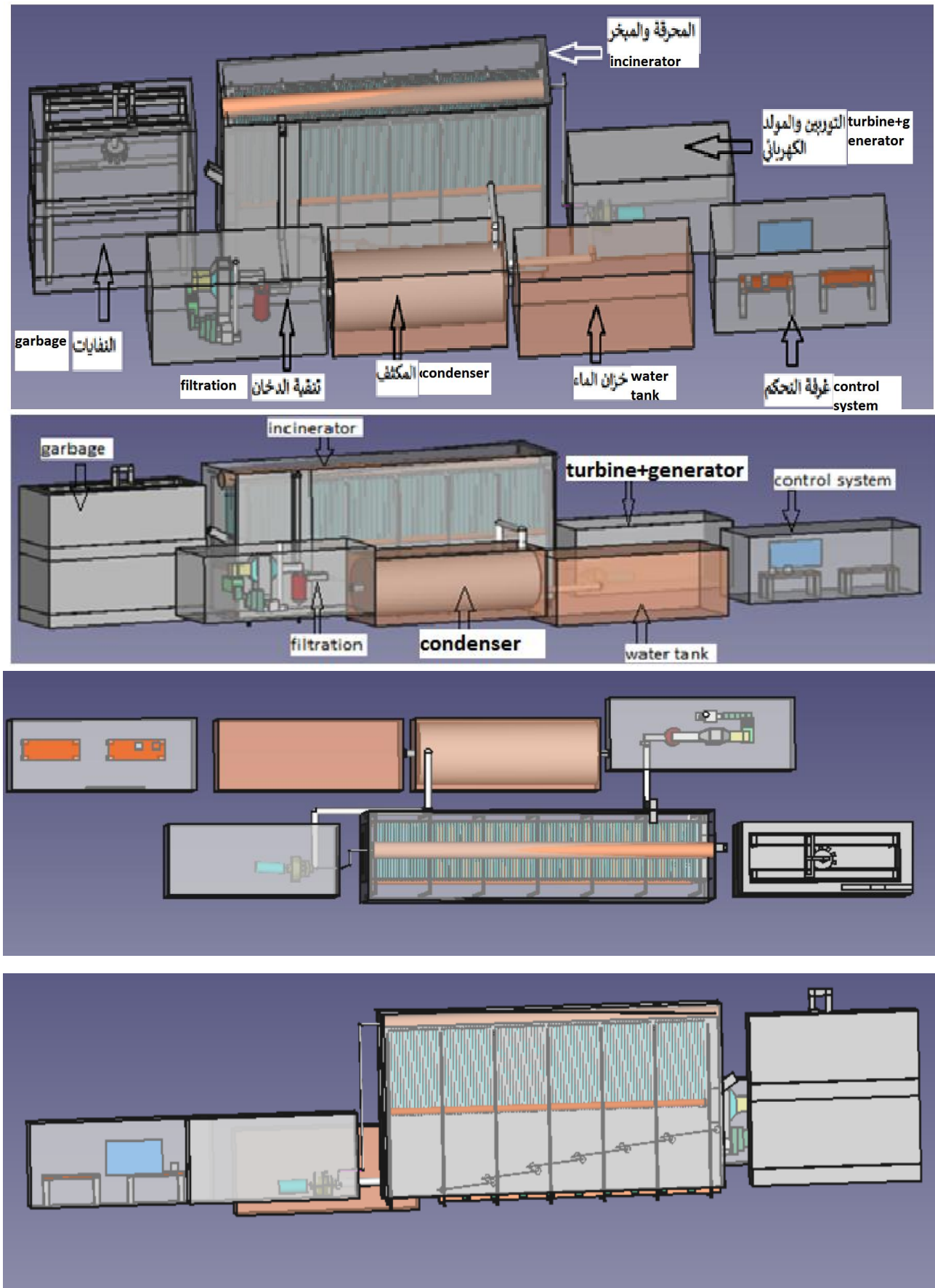
هذا المشروع يهدف الى تصنيع اول محطة صنع معظم الاجزاء من مؤسسة طاقة الشمال ومن ضمن ذلك التوربين.

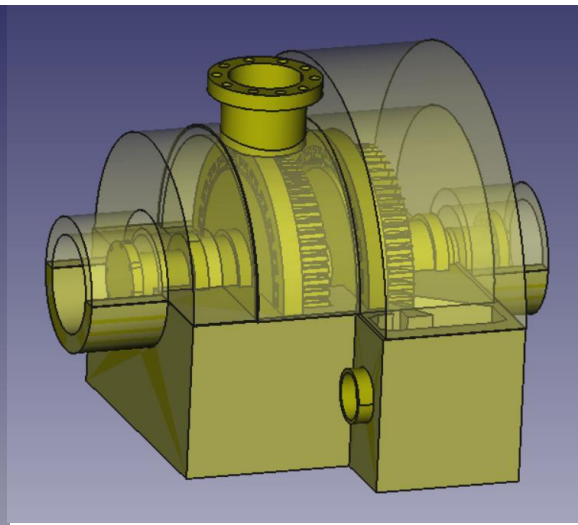
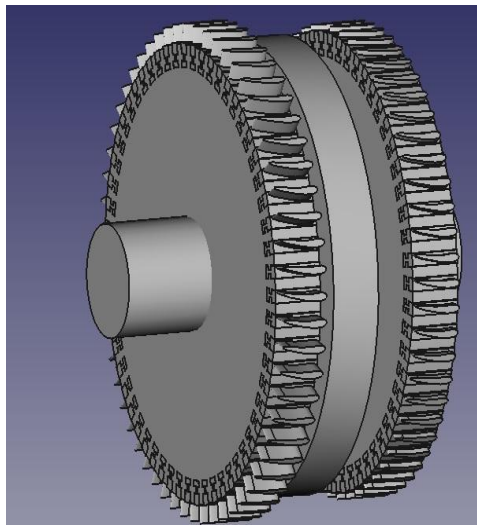
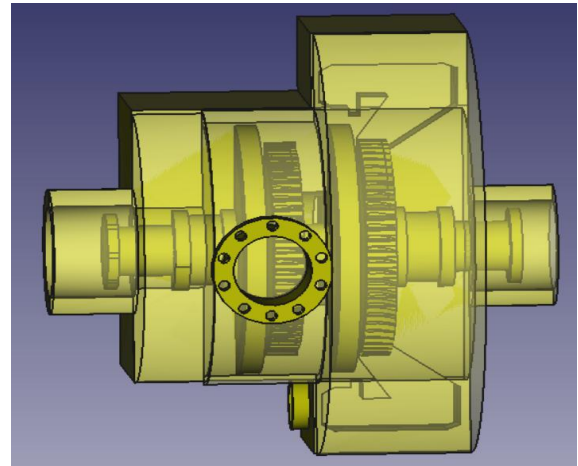
REQVIEW-NEEDS: ReqView Business Needs

File Edit View Project Help

Filter

Contents	* ID	Description	As a(n)	Attributes
1 Introduction	NEEDS-2	1 Introduction		Type: Information
1.1 Purpose	NEEDS-46	1.1 Purpose This is a <i>demo document</i> describing business needs for development of <a href="#">ReqView Desktop</a> tool. The document is not complete.		
1.2 Intended Audience and Reading Suggestions	NEEDS-49	1.2 Intended Audience and Reading Suggestions The target audience for this document are new ReqView users evaluating ReqView and learning how to gather and manage requirements in ReqView.		
2 User Roles	NEEDS-1	2 User Roles		
2.1 Requirements Architect				
2.2 Editor				
2.3 Reviewer				
3 User Stories				
3.1 Data Model				





### 4.1.1 Steam system parameters for a 2MW Turbine (14 bar, 195°C)

- Main
- About
- Preferences
- Glossary
- Resources
- Tutorials
- Properties Calculators:
  - Saturated Properties
  - Steam Properties
- Equipment Calculators:
  - Boiler
  - Heat Loss
  - Flash Tank
  - PRV w/ Desuperheating
  - Header
  - Deaerator
  - Steam Turbine
- Steam System Modeler

#### Steam Turbine Calculator [watch tutorial](#) [view guide](#)

Calculates the energy generated or steam outlet conditions for a steam turbine.

Solve for:	
<input type="text" value="Outlet Properties"/>	
Inlet Steam	
Pressure*	<input type="text" value="200"/> psig
Temperature	<input type="text" value="383"/> °F
Turbine Properties	
Selected Turbine Property	<input type="text" value="Power Out"/>
Isentropic Efficiency *	<input type="text" value="30"/> %
Generator Efficiency *	<input type="text" value="50"/> %
Power Out *	<input type="text" value="2000"/> kW
Outlet Steam	
Pressure*	<input type="text" value="30"/> psig
* Required <input type="button" value="Enter"/> <input type="button" value="reset"/>	

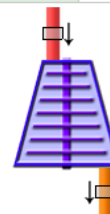
Examples:

Calculation Details and Assumptions below

#### WARNING:

- Inlet Steam Contains Condensate
- Steam Condensing in Turbine

Inlet Steam		Mass Flow	5,502.0 <i>klb/hr</i>
Pressure	200.0 <i>psig</i>	Sp. Enthalpy	356.8 <i>btu/lbm</i>
Temperature	383.0 <i>°F</i>	Sp. Entropy	0.545 <i>btu/lbm/R</i>
Phase	Liquid	Energy Flow	1,963.2 <i>MMBtu/hr</i>



Isentropic Efficiency	30.0 %
Energy Out	13.6 <i>MMBtu/hr</i>
Generator Efficiency	50.0 %
Power Out	2,000.0 <i>kW</i>

Outlet Steam		Mass Flow	5,502.0 <i>klb/hr</i>
Pressure	30.0 <i>psig</i>	Sp. Enthalpy	354.3 <i>btu/lbm</i>
Temperature	274.0 <i>°F</i>	Sp. Entropy	0.553 <i>btu/lbm/R</i>
Saturated	0.12	Energy Flow	1,949.5 <i>MMBtu/hr</i>

required steam: about 2500 kg / hour.

Calculation details:

**Step 1: Determine Inlet Properties**

Using the Steam Property Calculator, properties are determined using Inlet Pressure and the selected second parameter (Temperature, Specific Enthalpy, Specific Entropy, or Quality). The Specific Enthalpy is then multiplied by the Mass Flow to get the Energy Flow:

- Pressure = 200.0 psig
- Temperature = 383.0 °F
- [Steam Property Calculator] => Specific Enthalpy = 356.8 btu/lbm
- Inlet Energy Flow = Specific Enthalpy \* Mass Flow  
[ Inlet Energy Flow = 1,963.2 MMBtu/hr = 356.8 btu/lbm \* 5,502.0 klb/hr ]

**Step 2: Calculate Ideal Outlet Properties (Inlet Entropy equals Outlet Entropy)**

- Pressure = 30.0 psig
- Specific Entropy = 0.545 btu/lbm/R
- [Steam Property Calculator] => Specific Enthalpy = 348.5 btu/lbm

**Step 3: If solve for 'Isentropic Efficiency', Determine Outlet Properties**

Using the outlet specific enthalpy, calculate the isentropic efficiency:

- Isentropic Efficiency = (Inlet Specific Enthalpy - Outlet Specific Enthalpy) / (Inlet Specific Enthalpy - IDEAL Outlet Specific Enthalpy)

**Step 3: If solve for 'Outlet Properties', Determine Outlet Specific Enthalpy**

1. Isentropic Efficiency = (Inlet Specific Enthalpy - Outlet Specific Enthalpy) / (Inlet Specific Enthalpy - IDEAL Outlet Specific Enthalpy)
2. Isentropic Efficiency \* (Inlet Specific Enthalpy - IDEAL Outlet Specific Enthalpy) = (Inlet Specific Enthalpy - Outlet Specific Enthalpy)
3. Outlet Specific Enthalpy = Inlet Specific Enthalpy - Isentropic Efficiency \* (Inlet Specific Enthalpy - IDEAL Outlet Specific Enthalpy)  
[Outlet Specific Enthalpy = 354.3 btu/lbm = 356.8 btu/lbm - 30.00 % \* (356.8 btu/lbm - 348.5 btu/lbm)]

Using the outlet specific enthalpy, calculate the outlet properties:

- Pressure = 30.0 psig
- Specific Enthalpy = 354.3 btu/lbm
- [Steam Property Calculator] => Temperature = 274.0 °F

**Step 4: Calculate Steam Turbine Energy Out and Generation (Power Out)**

- Energy Out = (Inlet Specific Enthalpy - Outlet Specific Enthalpy) \* Mass Flow  
[Energy Out = 13.6 MMBtu/hr = (356.8 btu/lbm - 354.3 btu/lbm) \* 5,502.0 klb/hr]
- Power Out = Energy Out \* Generator Efficiency  
[Power Out = 2,000.0 kW = 13.6 MMBtu/hr \* 50.00 %]

# RIYAKO

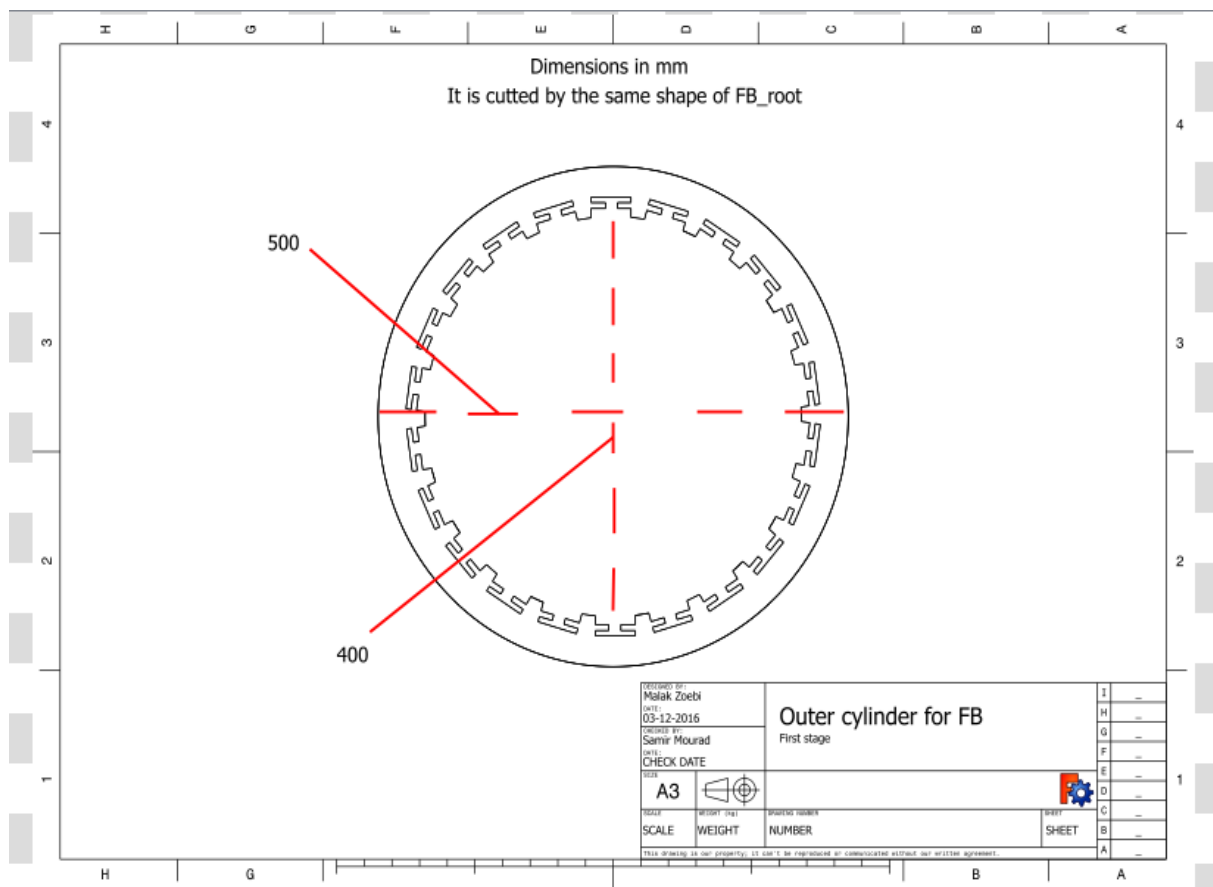
## INVOICE

Bill To		Ship To	
<b>Customer</b>	North Lebanon Power Plant	<b>Recipient</b>	[Recipient Name]
<b>Customer ID#</b>	[Customer ID]	<b>Address</b>	[Company]
<b>Address</b>	Mina-behind France-Lebanon' bank	<b>Address</b>	[Address]
<b>Phone</b>	06612004	<b>Phone</b>	[City, ST ZIP Code]
			[Telephone]
<b>Payment Due</b>	[Select Date]	<b>Delivery Date</b>	[Select Date]
<b>Salesperson</b>	[Salesperson Name]	<b>Shipping Method</b>	[Ship Method]
<b>Payment Terms</b>	[Terms]	<b>Shipping Terms</b>	[Terms]

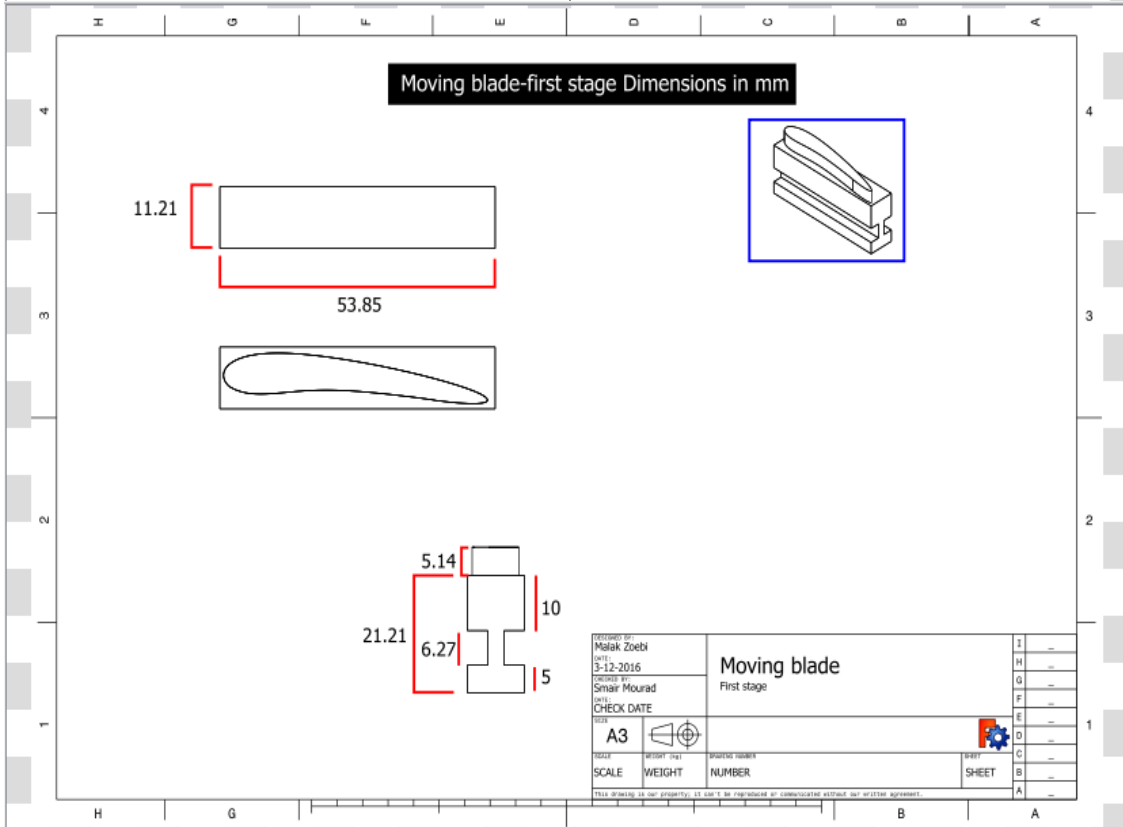
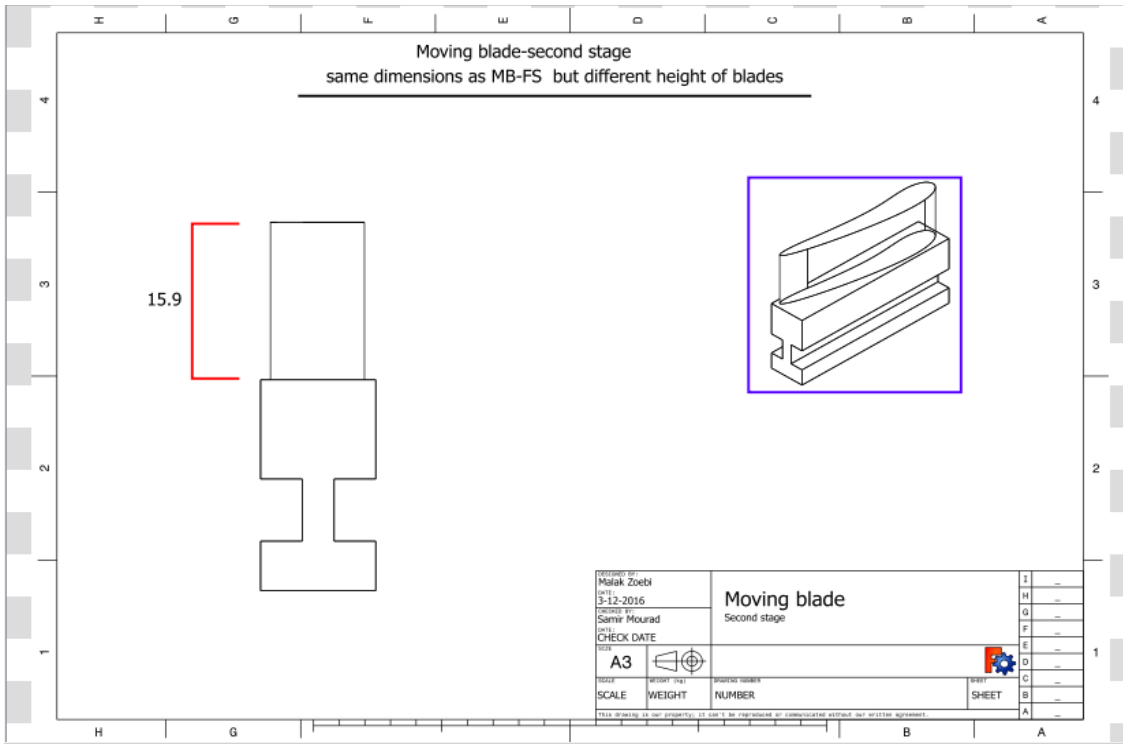
Qty.	Item#	Description	Unit Price	Discount	Line Total
22	FB-FS	Fixed blade for the first stage			
23	FB-SS	Fixed blades for the second stage			
58	MB-FS	Moving blades for the first stage			
58	MB-SS	Moving blades for the second stage			
2	Cyld for MB	Cylinder for moving blades			
1	Cyld for FB-FS	Cylinder for fixed blades-first stage			
1	Cyld for FB-SS	Cylinder for fixed blades-second stage			
Total Discount					
Subtotal					
Sales Tax					
<b>Total</b>					

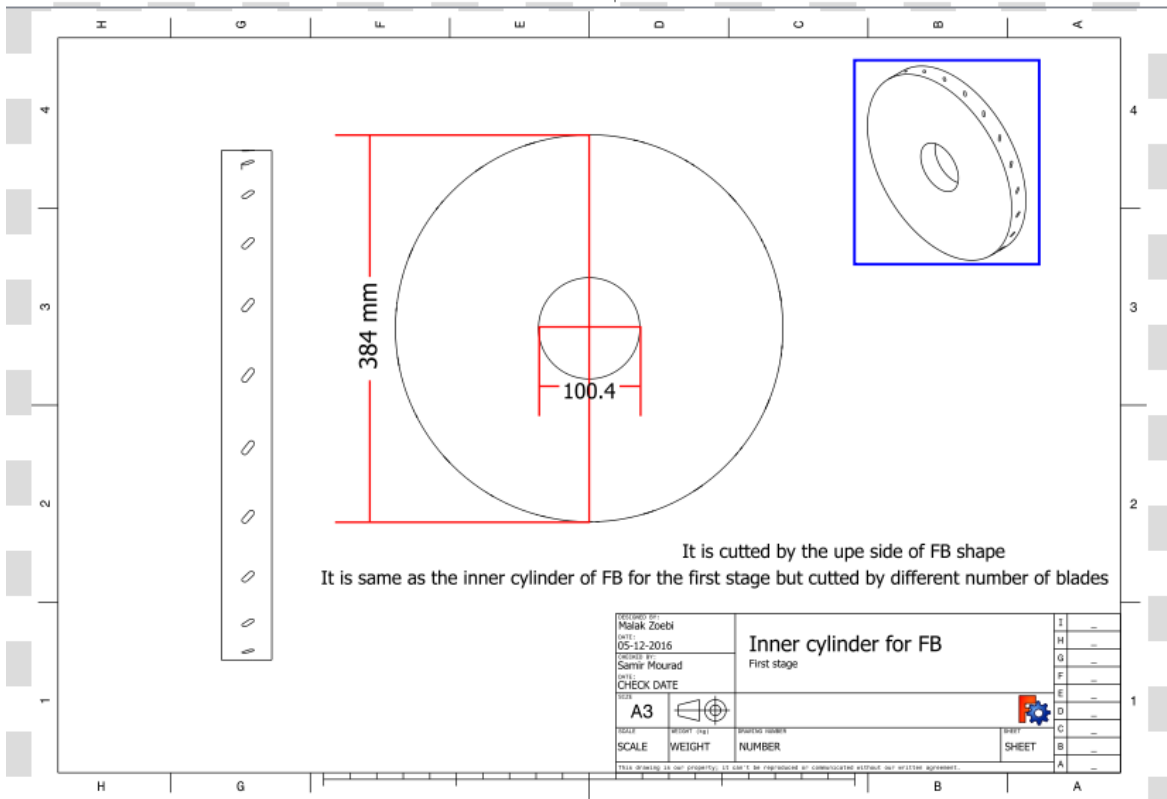
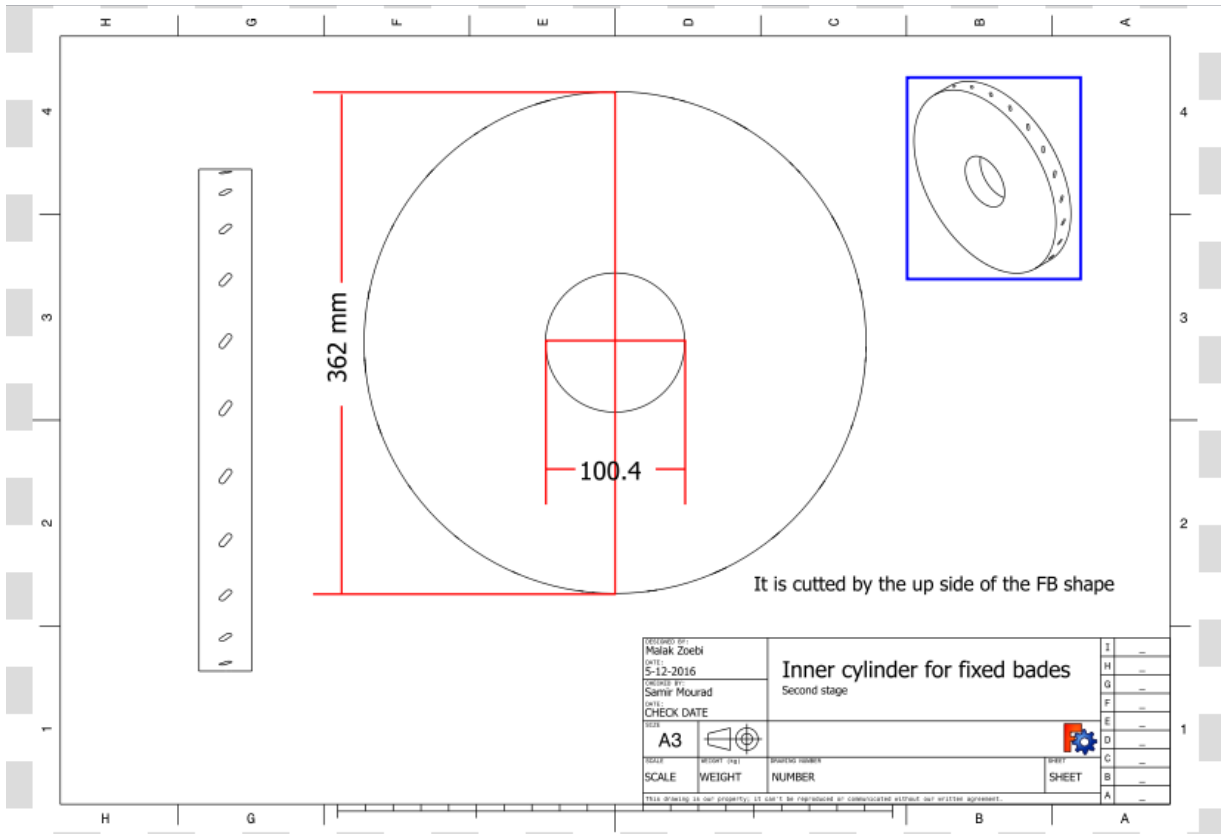
**Thank you for your business!**

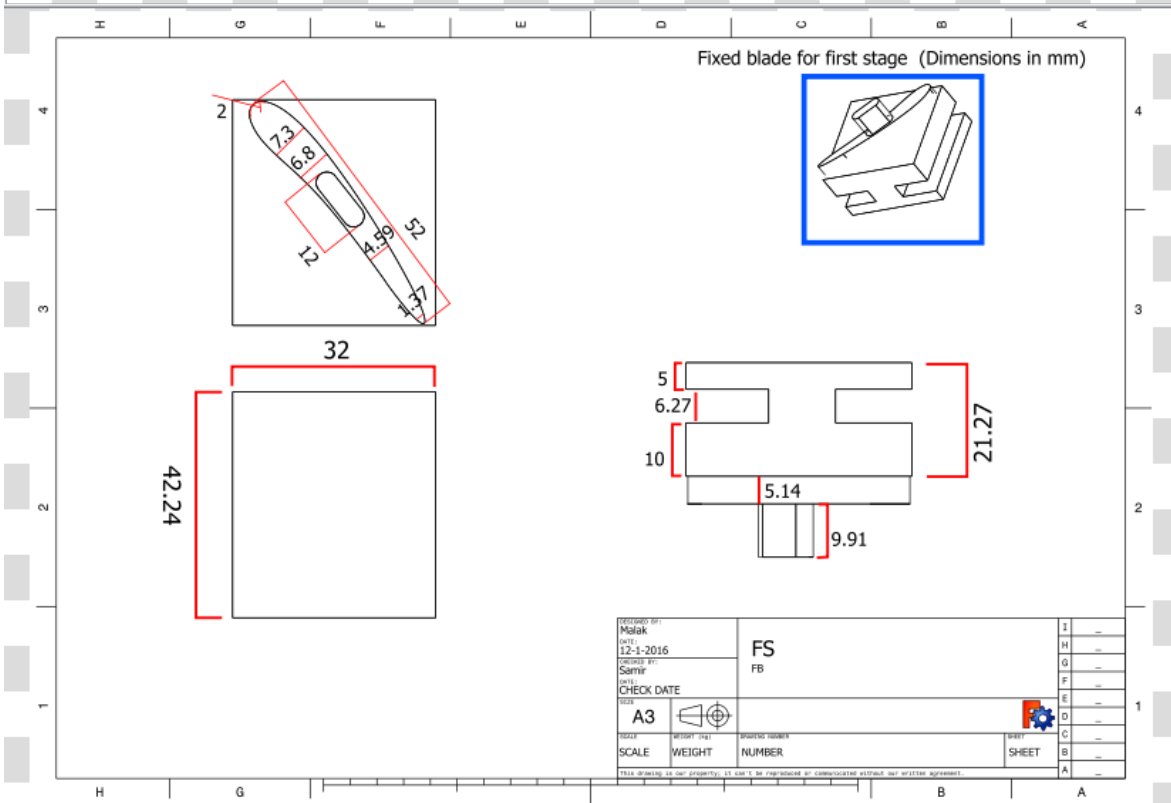
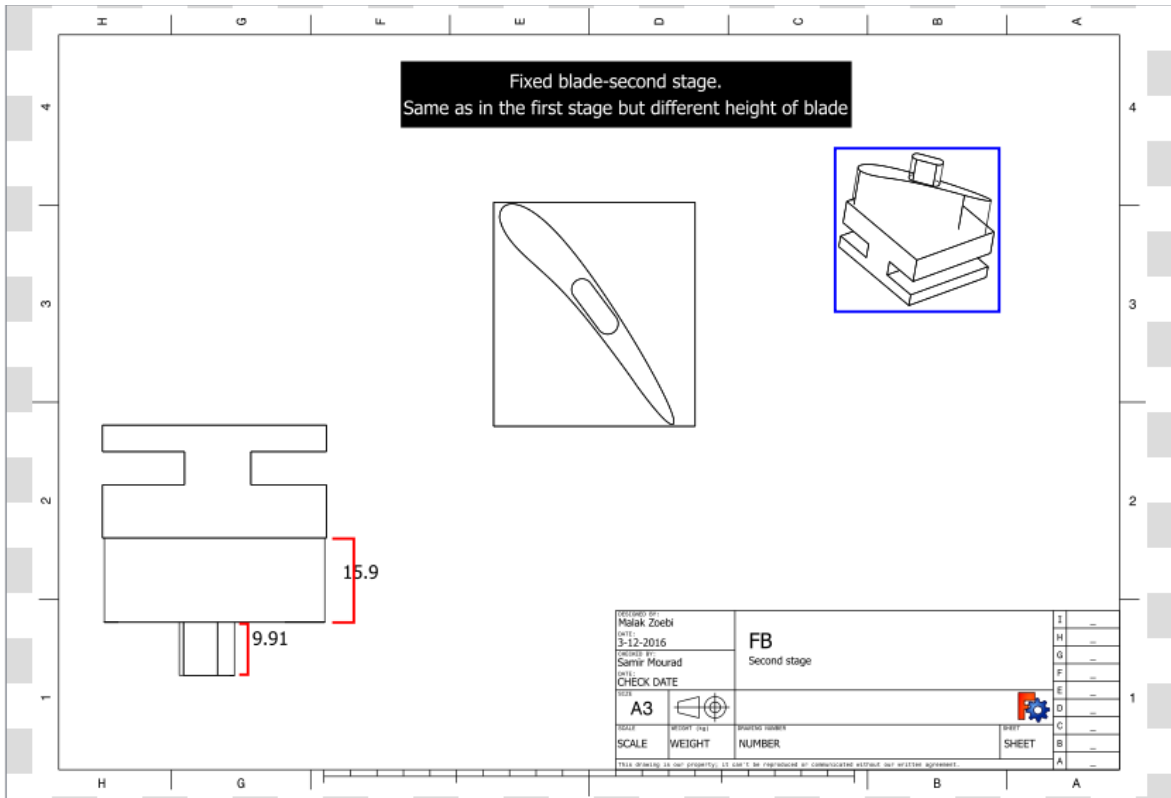
2D picture for each part of turbine:

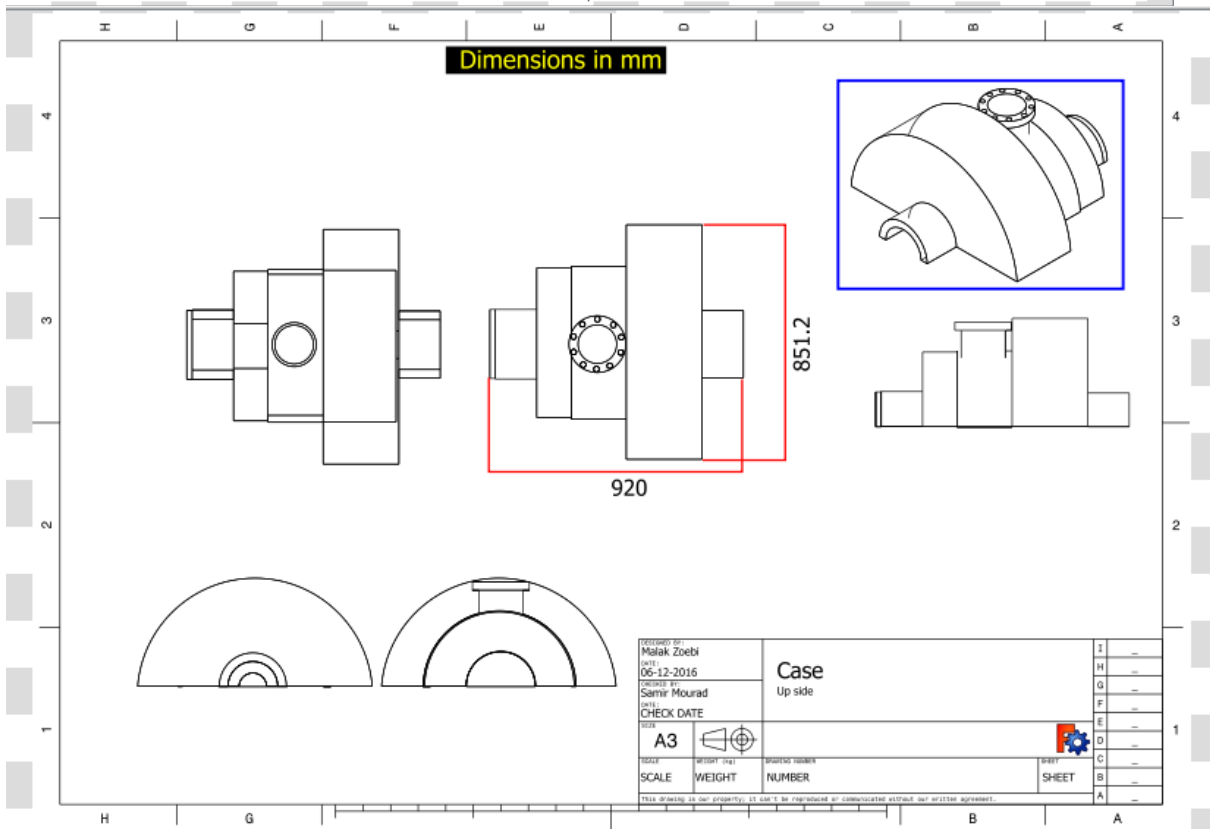
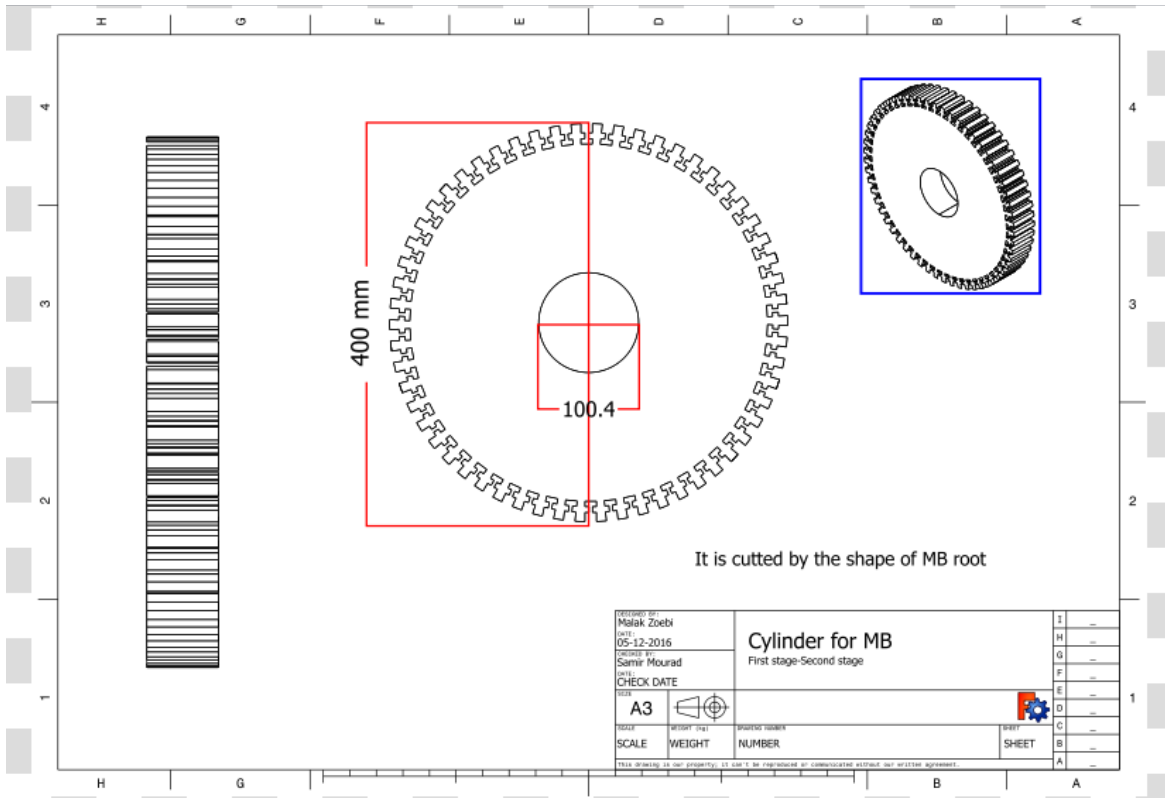


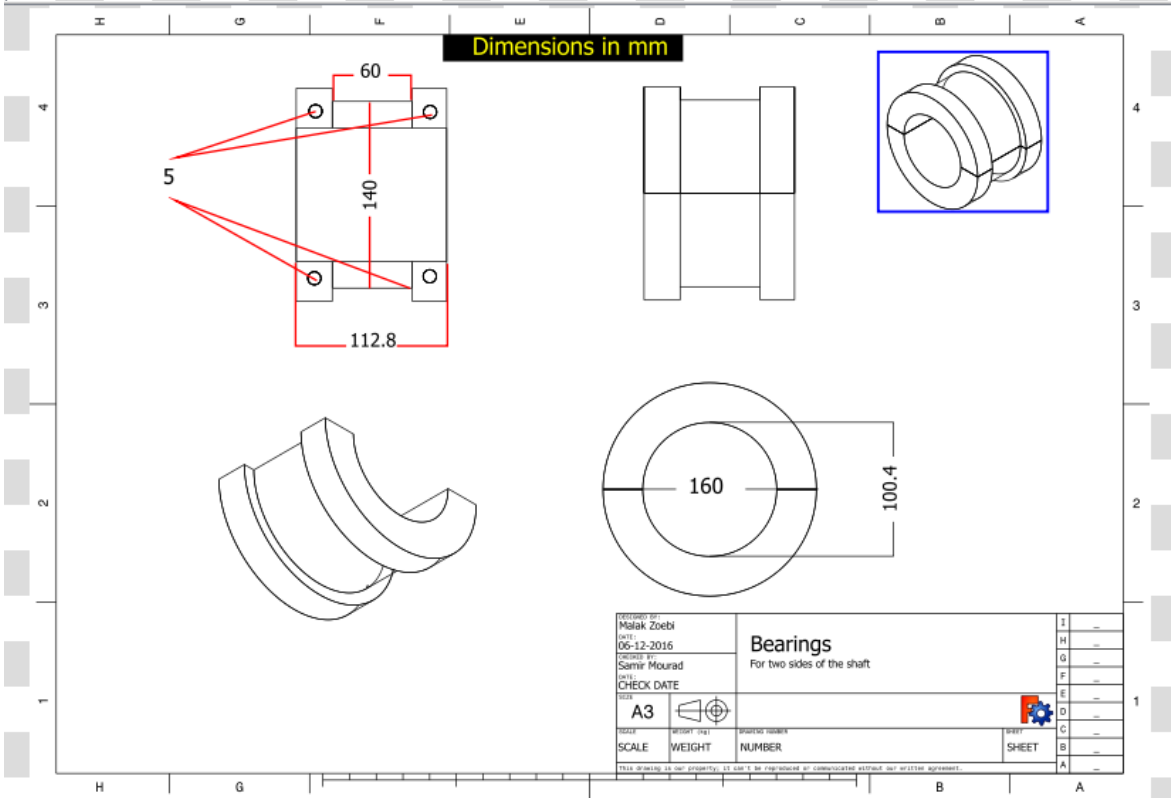
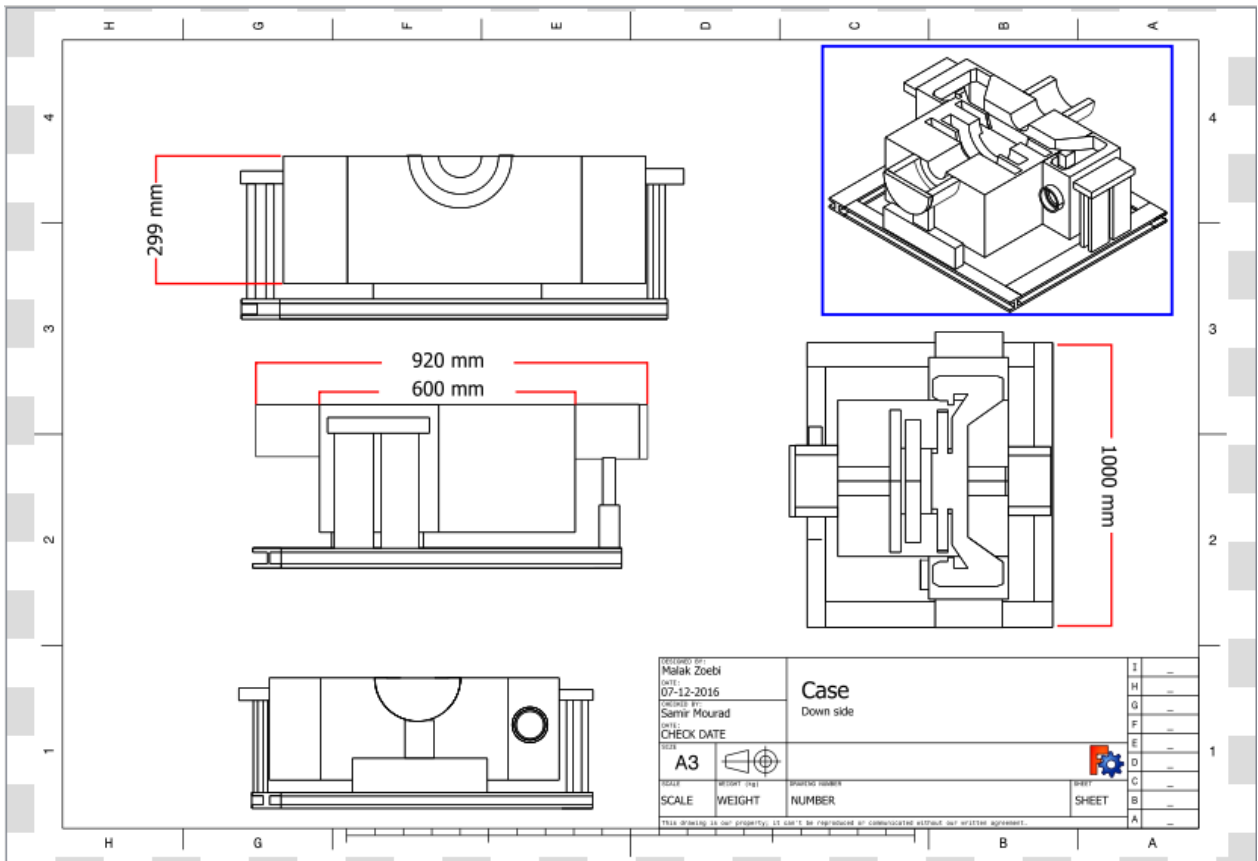


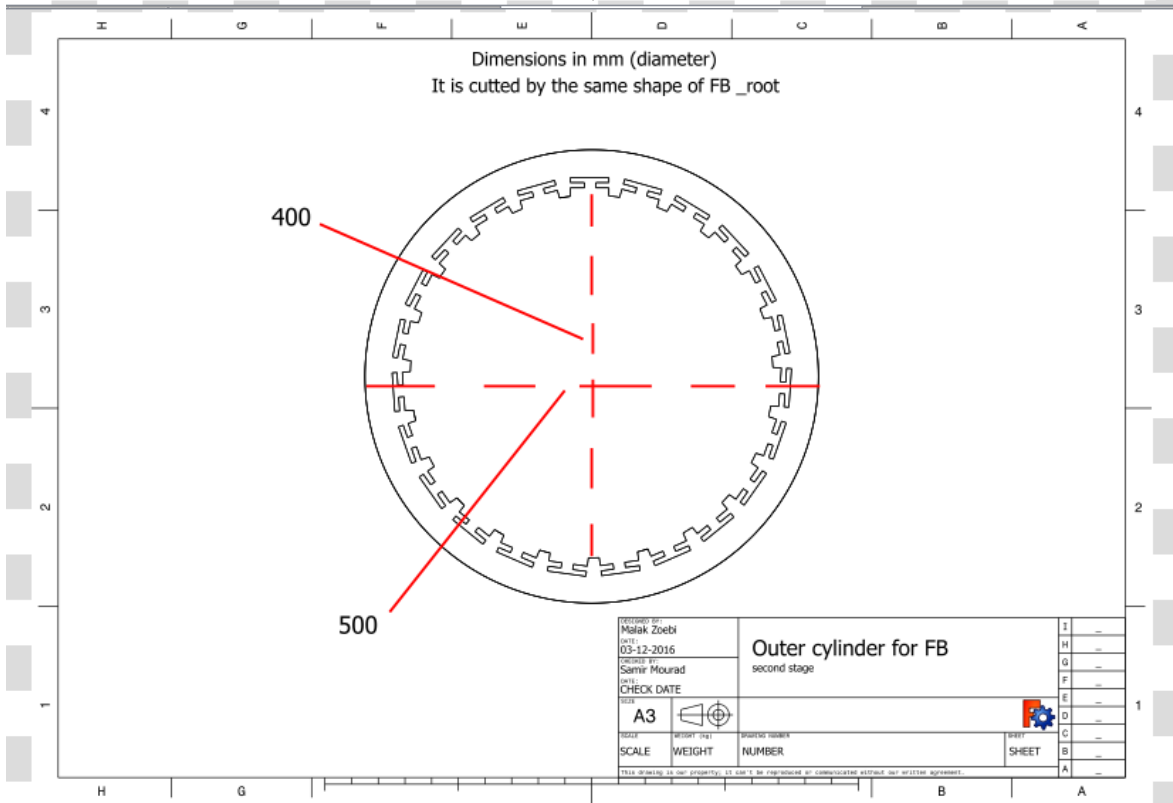
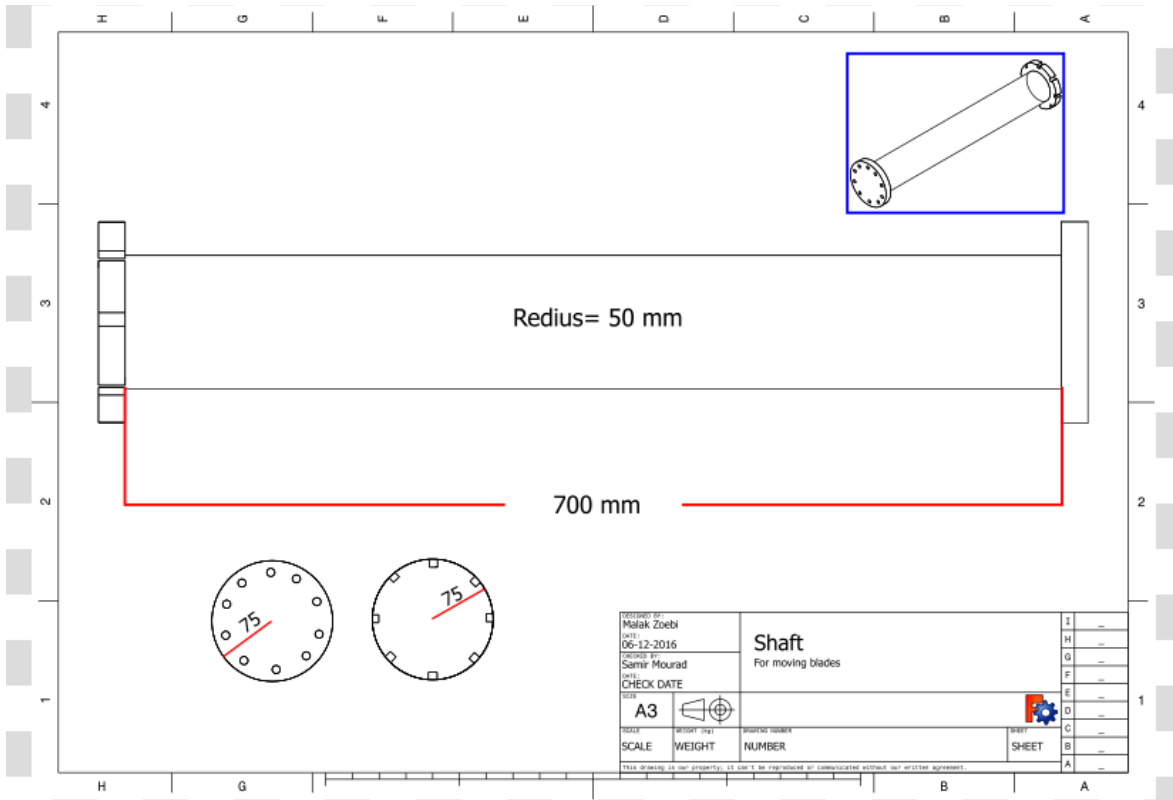




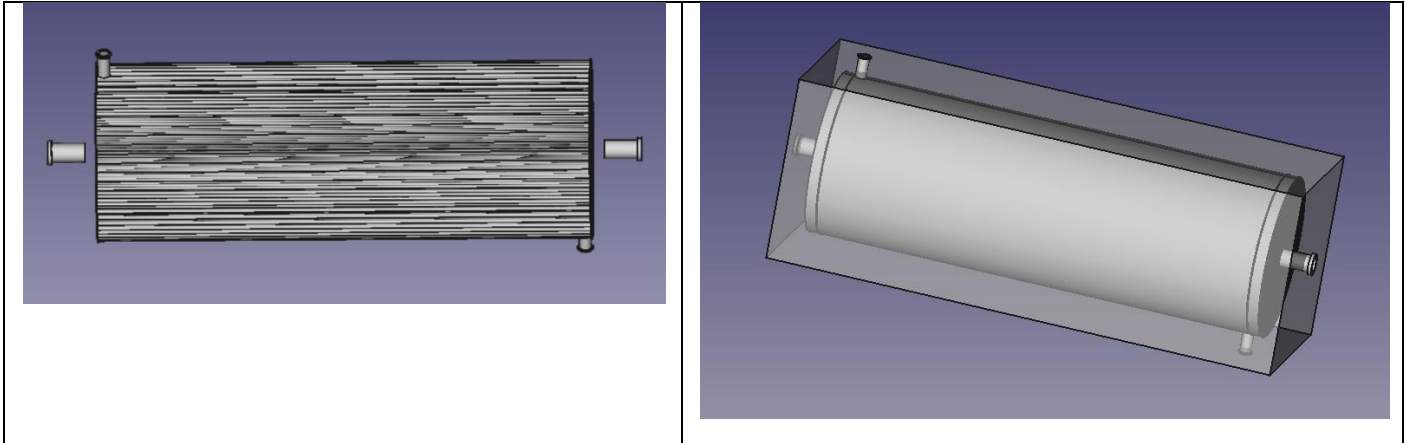








#### 4.1 dynamo generator

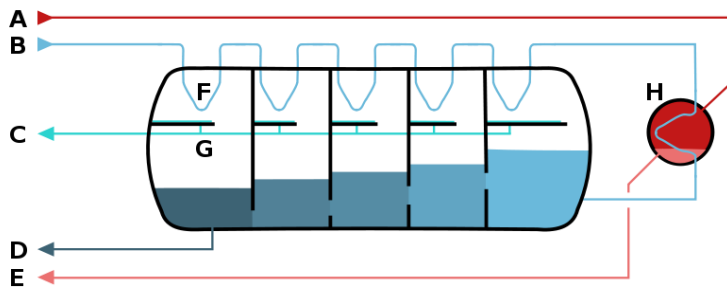
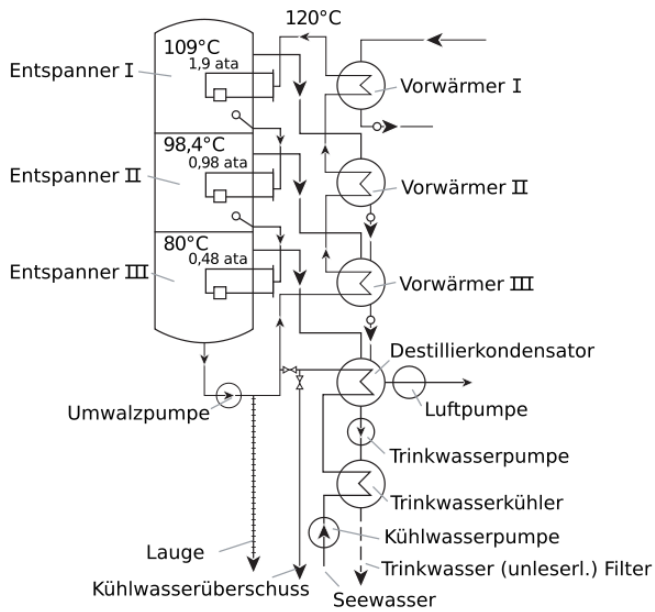


- Length: 6 m, Number of tubes 530
- 1 tube (50cm as rad 20'';6 m)
- Heat transfer between steam and water
- Heat transfer between steam and water



## 6 Cooling of Condensator

### 6.1 Sea water desalting unit for condenser cooling cycle



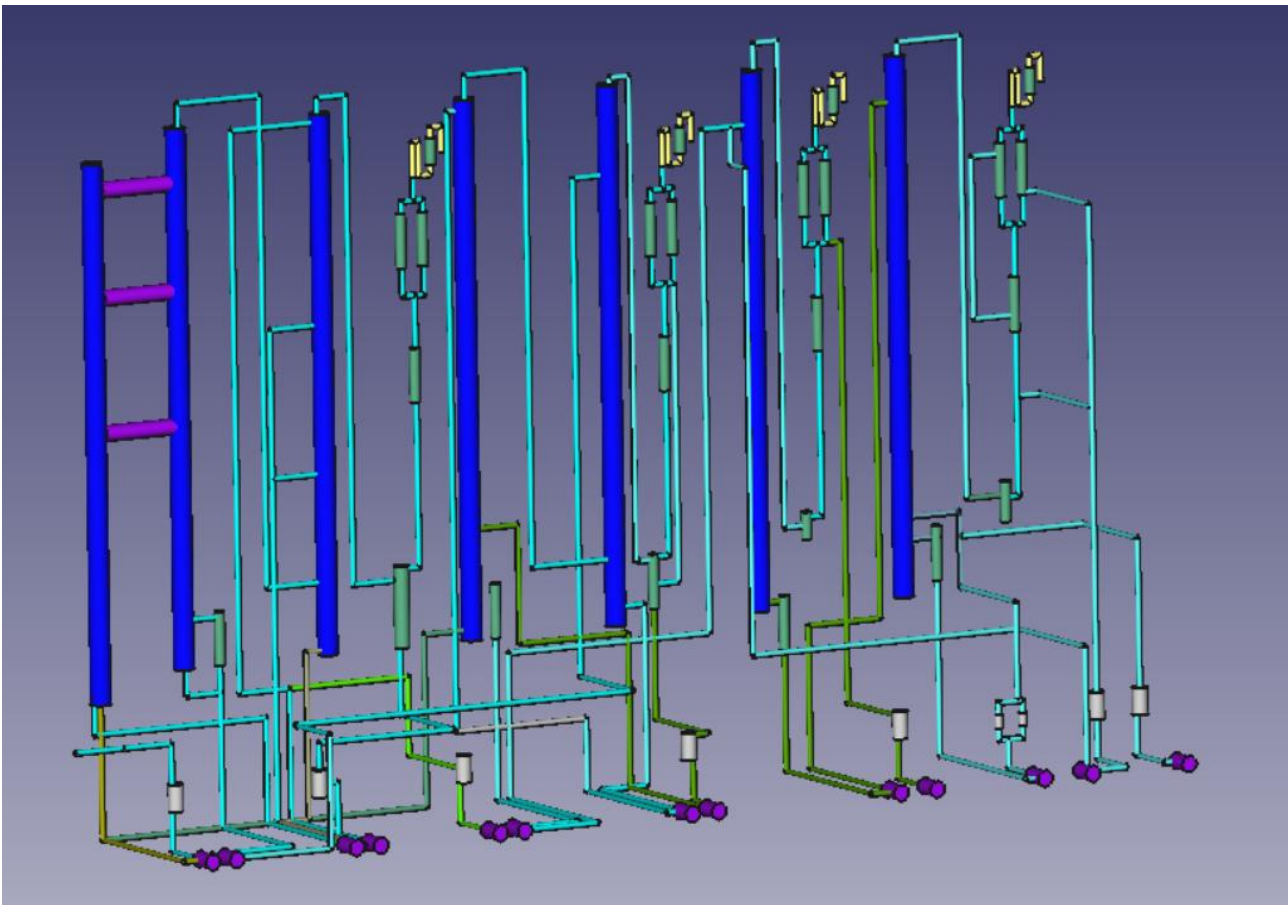
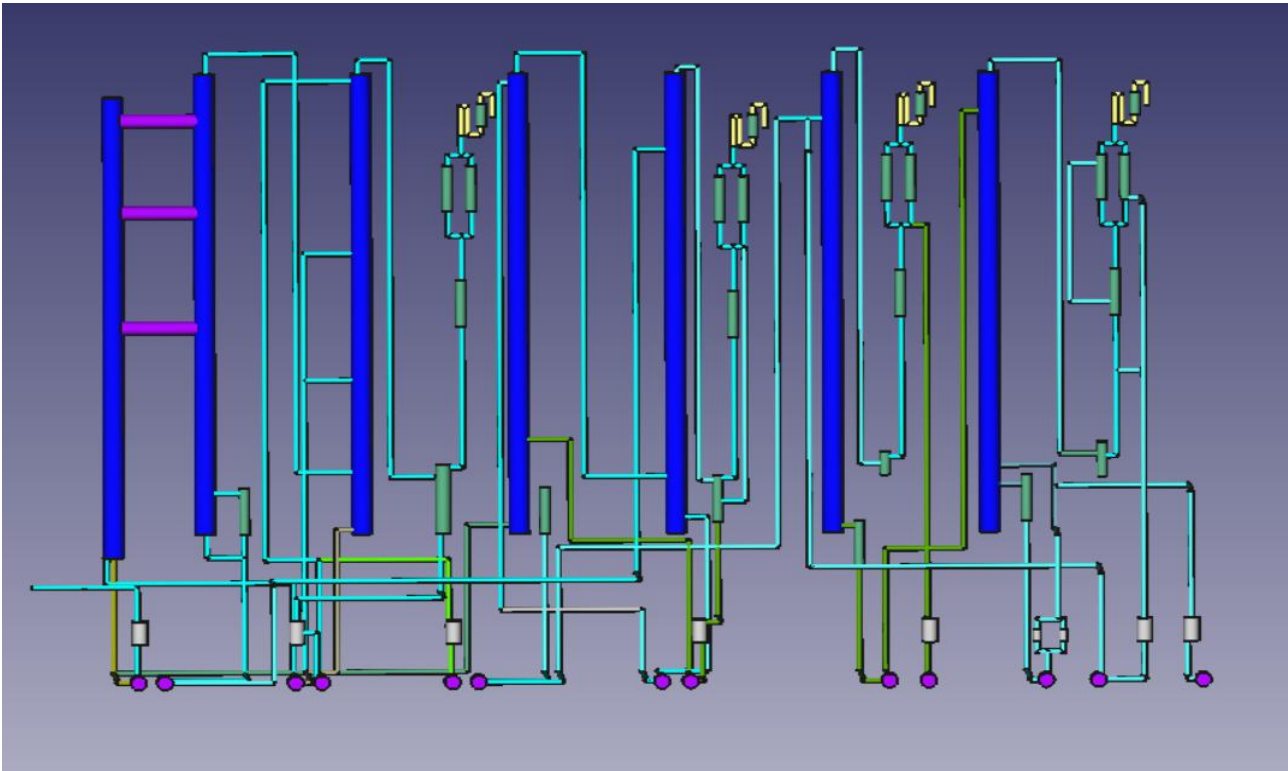
Schematic of a [multistage flash desalinate](#)

water out, D – waste out, E – steam out

A – steam in, B – seawater in, C – potable

F – heat exchange, G – condensation

collection, H – brine heater



## 6.2 Cost for cooling (with fresh sea water cycle)

- 500 متر بعيد من البحر: 1000 متر انابيب

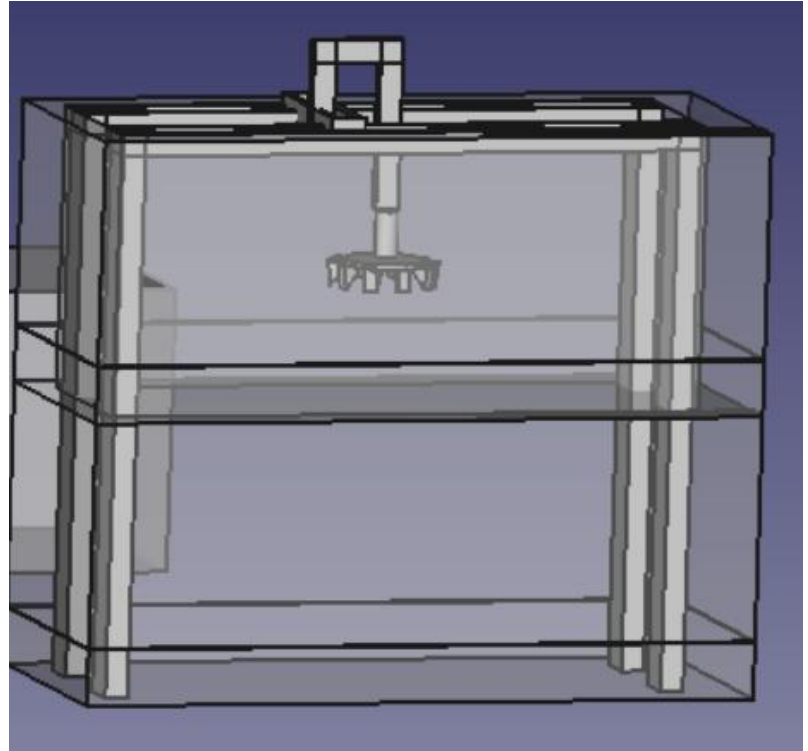
Cooling					
	Length [m]	قصر 6 متر #	Price per pipe element	Total price	
Pipes	1000	167	\$30	\$5.000	
		#Pumps	Price per pump		
Pumps		2	\$200	\$400	
					Total cooling
					\$5.400

Length:6 m

Width:2 m

Hight:2 m

12 sheet of steel / (1:2m)/thickness :4 mm



Tubes: - vertical: 216 tube (2 inch, 2.5 m)

- horizontal : 216 tube (2 inch, 1 m)

- 4 tubes (4 inch, 12 m )

- 216 flosse (2 inch)

sheet - 30 sheet (1:2 m) with thickness 4 mm

- 12 sheet (1:2 m) with thickness 4 mm

- 12 sheet (1:2 m) with thickness 4 mm to the incinerator

- sheet should be steel or stainless 306

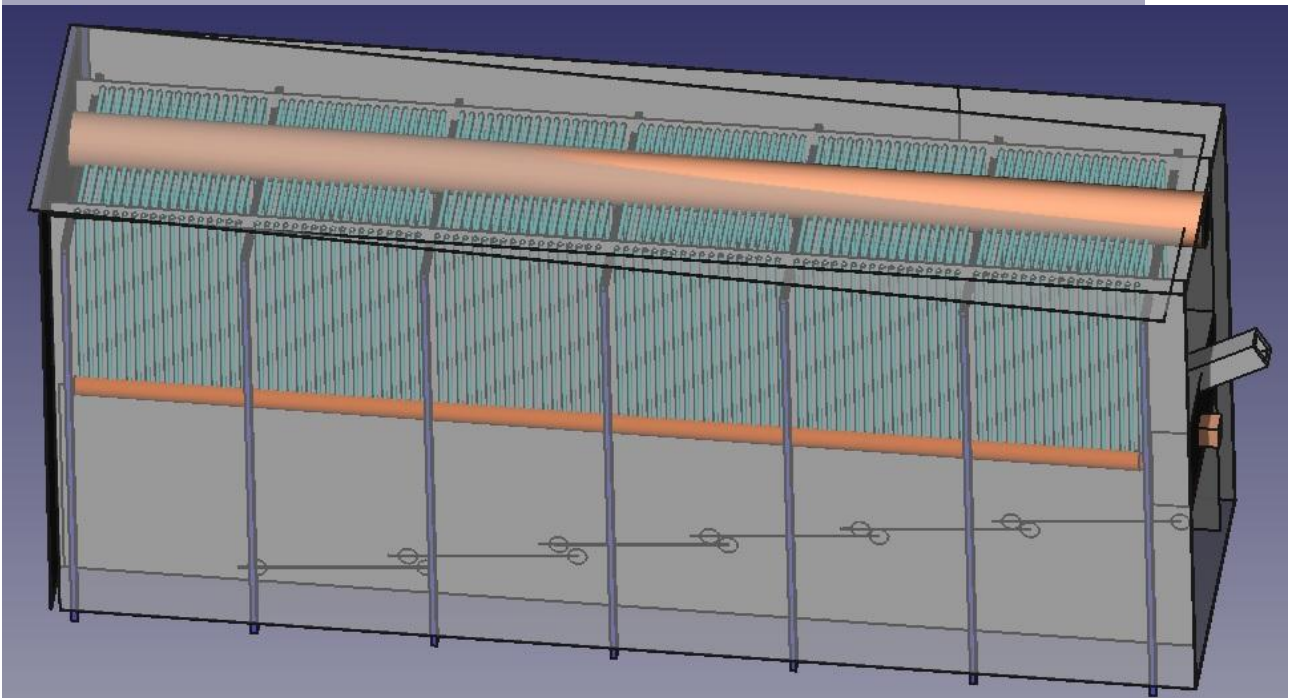
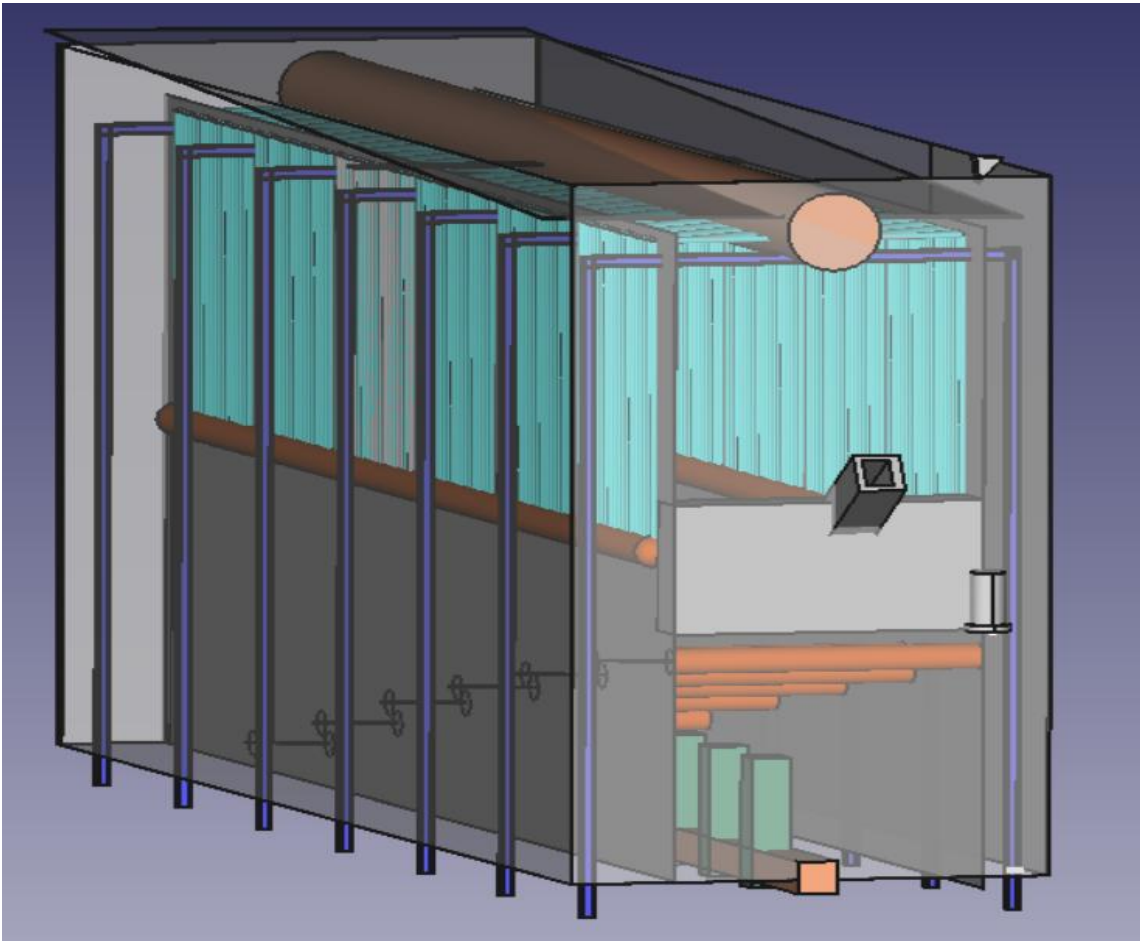
- vaporiser : tube (rad=4'', length 12 m)

Tube:\* between condensor and turbine :

-2 tubes: length (6m),rad(4'')

\*tube between inc and turbine :length (6m),rad(2'')

المحرقة والمبخر (incinerator)



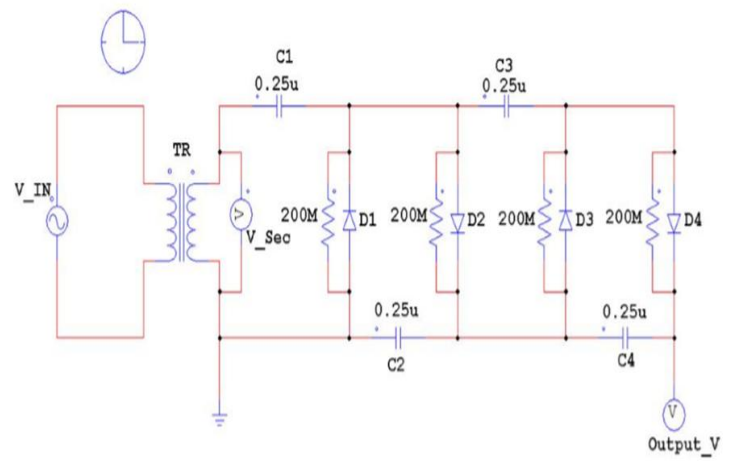
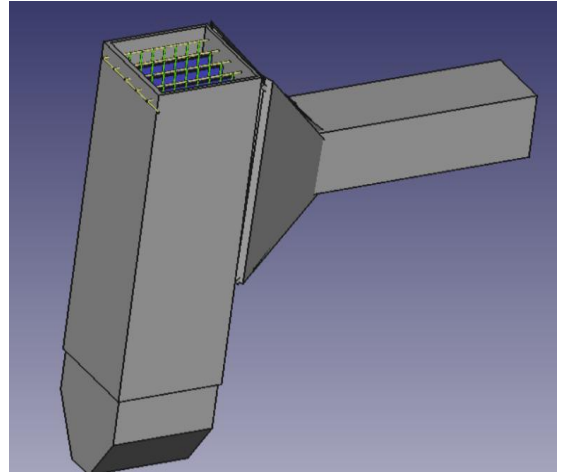
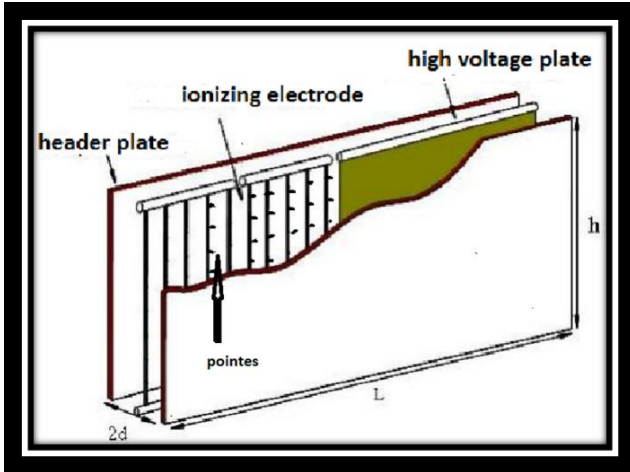
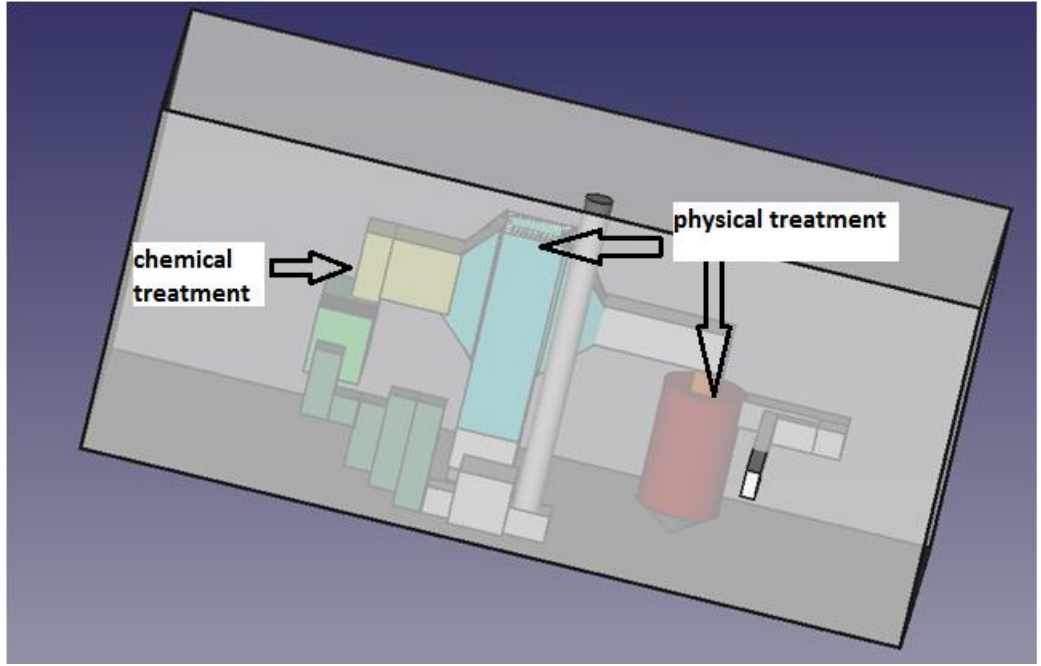


Figure 1:electrofilter





انظر Master Thesis Maysaa Kamareddine, 2016

ESP<sup>1</sup>

quality	عرض (متر) Width	طول (متر) Length	العدد Quantity	السماكة (مم) thickness
حديد مزيبق Iron quicksilver	1	2	6	0.5
فولاذ steel	1	2	1	5
قضيب نحاس Copper rod	قطر 6 مم	0.8	43	-

Inlet, outlet of ESP:

2 sheet (1:2m)

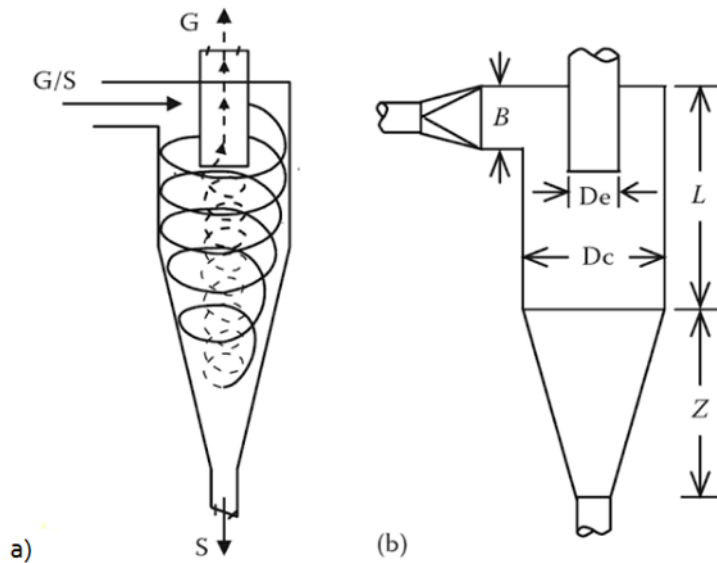
Chimney:

<sup>1</sup> Electrostatic precipitator

2 sheet (1:2m)

Cyclone:

2 sheet (1:2m) iron quicksilver



a) Flow pattern in cyclone separator. (b) Standard cyclone dimensions. S, solids; G, air;  $D_c$ , cyclone diameter;  $2D_c$ ;  $B = D_e = D_c/2$ .

	number	rad(inch)	length	prix(\$/6m) stainless 306	steel(\$/6m)	total (\$)
<b>incinerator</b>						
vertical tubes	216	2	2.5		50	\$4,500
horizontal tubes	216	2	1			
sheet for v.tubes	30	4 mm thic	(1:2 m)		70	\$2,100
sheet for h.tubes	12	4 mm thic	(1:2m)		70	\$840
sheet for inciner	12	6 mm thic	(1:2m)		70	\$840
tube for vaporiser	1	4	12		100	\$100
<b>condenser</b>						
tubes	530	1	6 m	120		\$63,600
tube	1	12	6 m			
<b>water tank</b>						

المواد الاولية التي نحتاجها لبناء محطة 2 ميغاوات

## 10.1 Incineration Tests<sup>2</sup>

### 10.1.1 Incineration without plastic



Figure 2:beginning of combustion

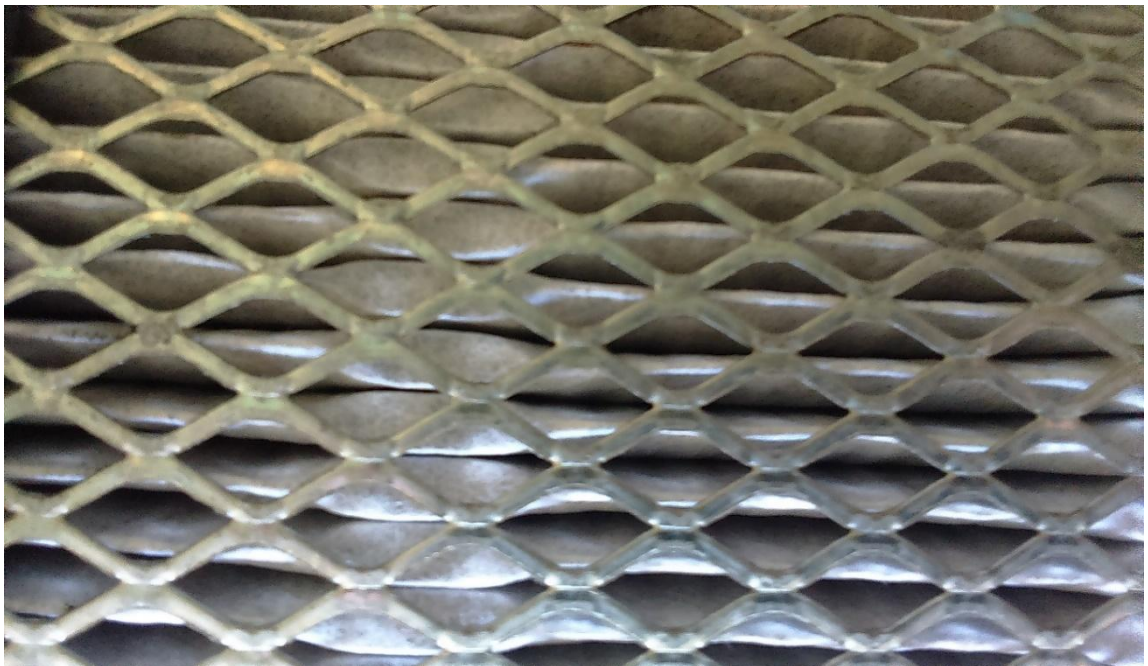


Figure 3: filter media after treatment

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<sup>2</sup> Master Thesis Maysaa Kamareddine, 2016



Figure 4:chimney during incineration

### Calculation of emissions

$$V_2 = V_1 * (P_1/P_2) * (T_2/T_1) * (Z_2/Z_1)$$

Converting to uniform units

$$V_1 = 314.000 \text{ Nm}^3/\text{h}$$

$$P_1 = 1.000 \text{ atm}$$

$$T_1 = 273.150 \text{ }^\circ\text{K}$$

$$T_2 = 323.150 \text{ }^\circ\text{K}$$

$$P_2 = 1.000 \text{ atm}$$

P1, T1 normal conditions

P2, T2 specification for exhaust

Z1=1 (ideal), Z2=1.01(at 1 atm): Compressibility Factor

Calculation for V2

$$V_2 = 314.000 * (1.000/1.000) * (323.150/273.150) * (1.100/1.100)$$

$$V_2 = 375 \text{ m}^3/\text{h}$$

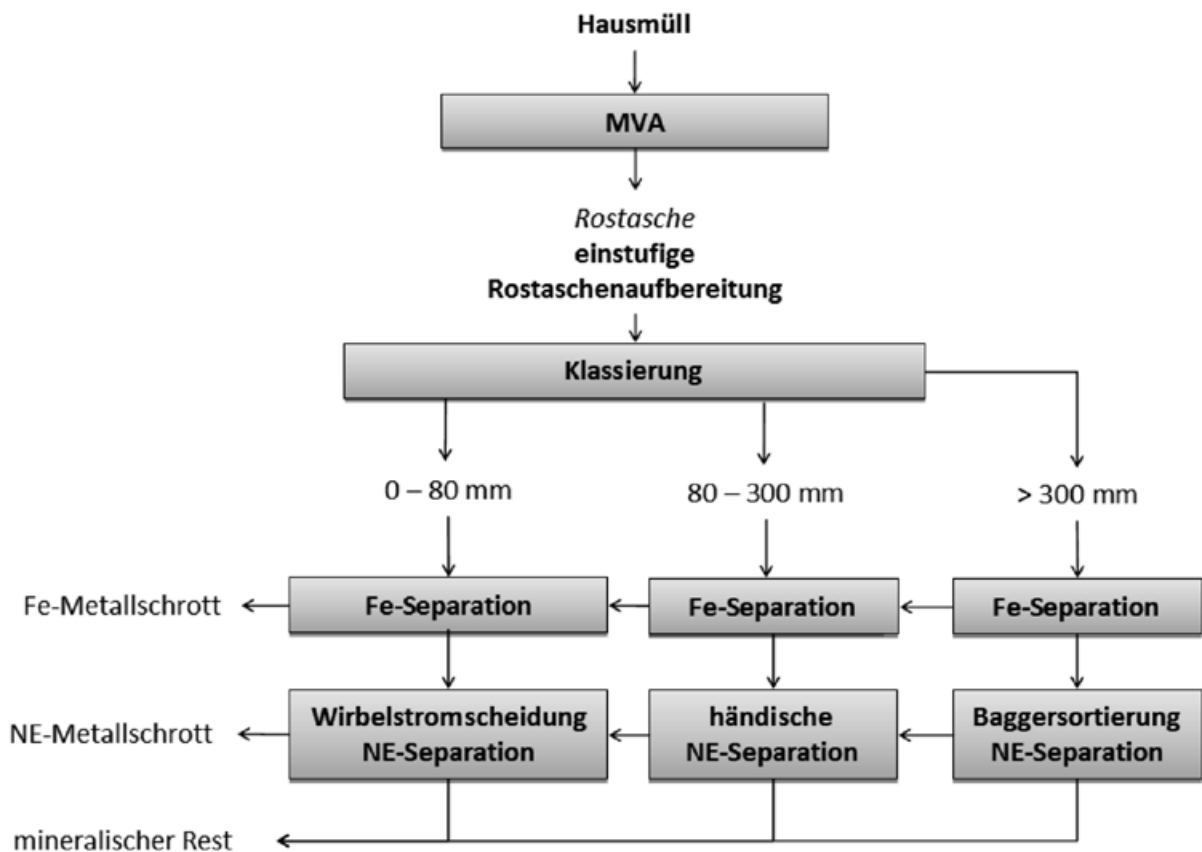
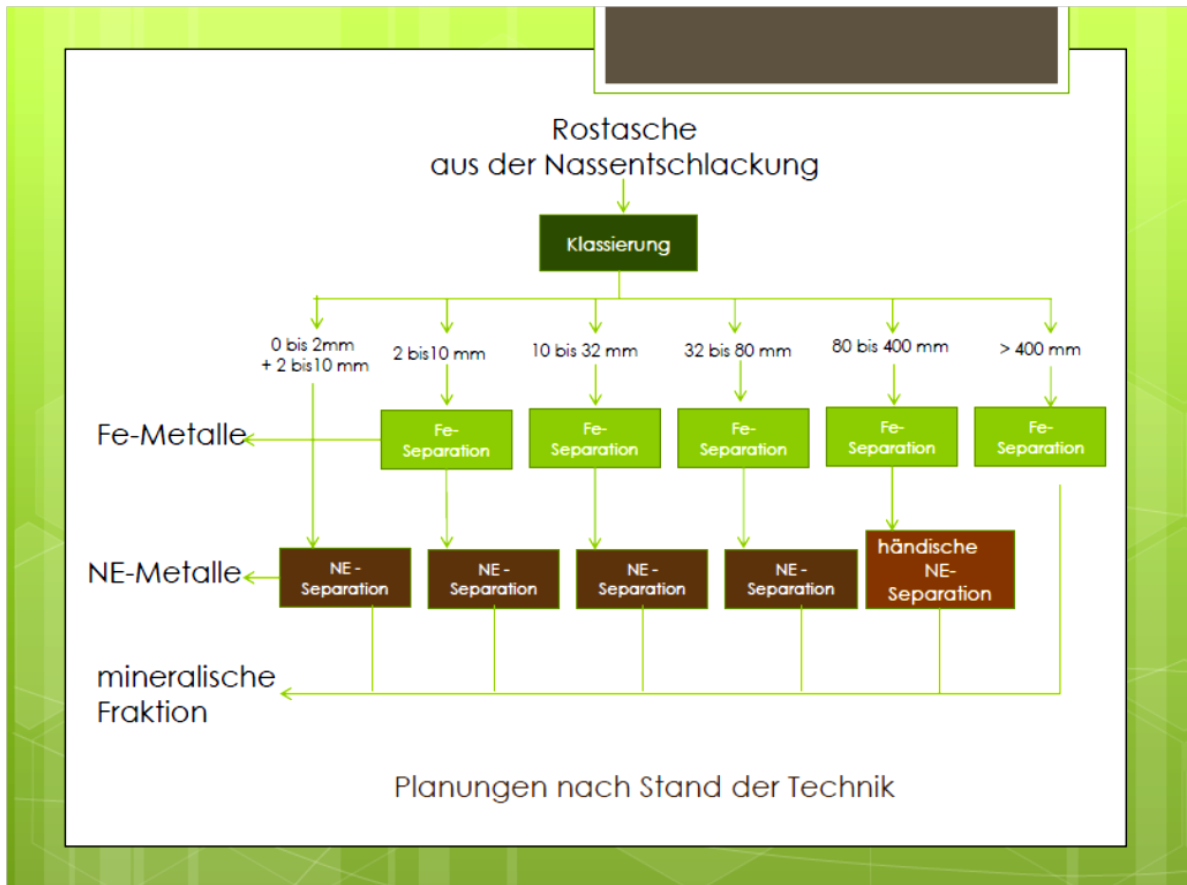
Or mass of filter before treatment =1300 g

mass after treatment =1364

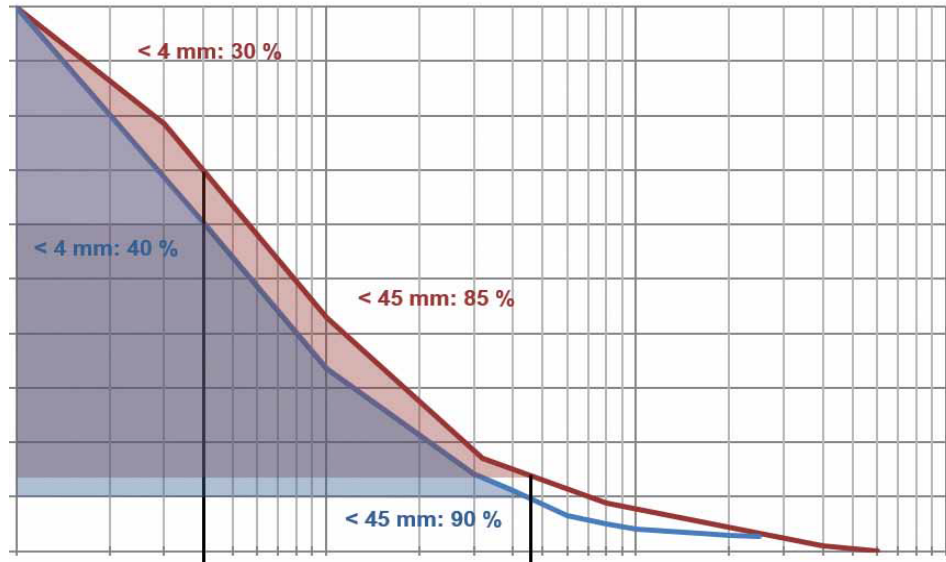
the total mass of particulate =1364-1300=64 g

375 m<sup>3</sup>/h correspond to 64 g

Thus 170 mg / m<sup>3</sup> <200 mg/ m<sup>3</sup> confirm to Lebanese standard (annex D) **positive results**



توزيع حجم الجسيمات  
من الرماد: ما بين 0 و  
45 ملمتر تشكل 90%  
من الرماد



Schadstoffe (Alwast)	
Parameter	Wertebereich
Arsen	3 bis 15 mg/kg
Blei	1.000 bis 3.500 mg/kg
Cadium	2 bis 20 mg/kg
Chrom ges.	200 bis 1.000 mg/kg
Kupfer	1.000 bis 10.000 mg/kg
Nickel	100 bis 500 mg/kg
Wertstoffe	
Parameter	Verwertbare Anteile
Fe-Metall	8 %
NE-Metall	2 %
VA-Metall	1 %

مثال

Die Metalle sind ferner in die Fraktionen Eisenmetalle (Fe) und Nichteisenmetalle (NE) zu unterteilen.

drei Hauptbestandteile der Rostasche

المكونات الرئيسية الثلاثة للرماد



84% معادن (minerals)

(وما لم تتغيره عملية الحرق مثل بطون ، حجر،

Im Hinblick auf eine spätere verfahrenstechnische Aufbereitung ist Rostasche in drei Hauptbestandteile aufzuteilen. Hierbei können aufgrund der Inhomogenität der Inputmaterialien nur Schwankungsbreiten angegeben werden. Das Bild 2 zeigt die beispielhafte Zusammensetzung aus uns vorliegenden Materialansprachen.

VA-Metall = Rostfreier Stahl (stainless steel)



# معالجة الرماد (Aufbereitung von Rostasche) بعد حرق النفايات المنزلية

ارميد، ...)

10% حديد (و الومينيوم، نحاس)

Unter den Metallen sind eisenhaltiger Schrott, Aluminium, )  
(Kupfer und Messing vorhanden)

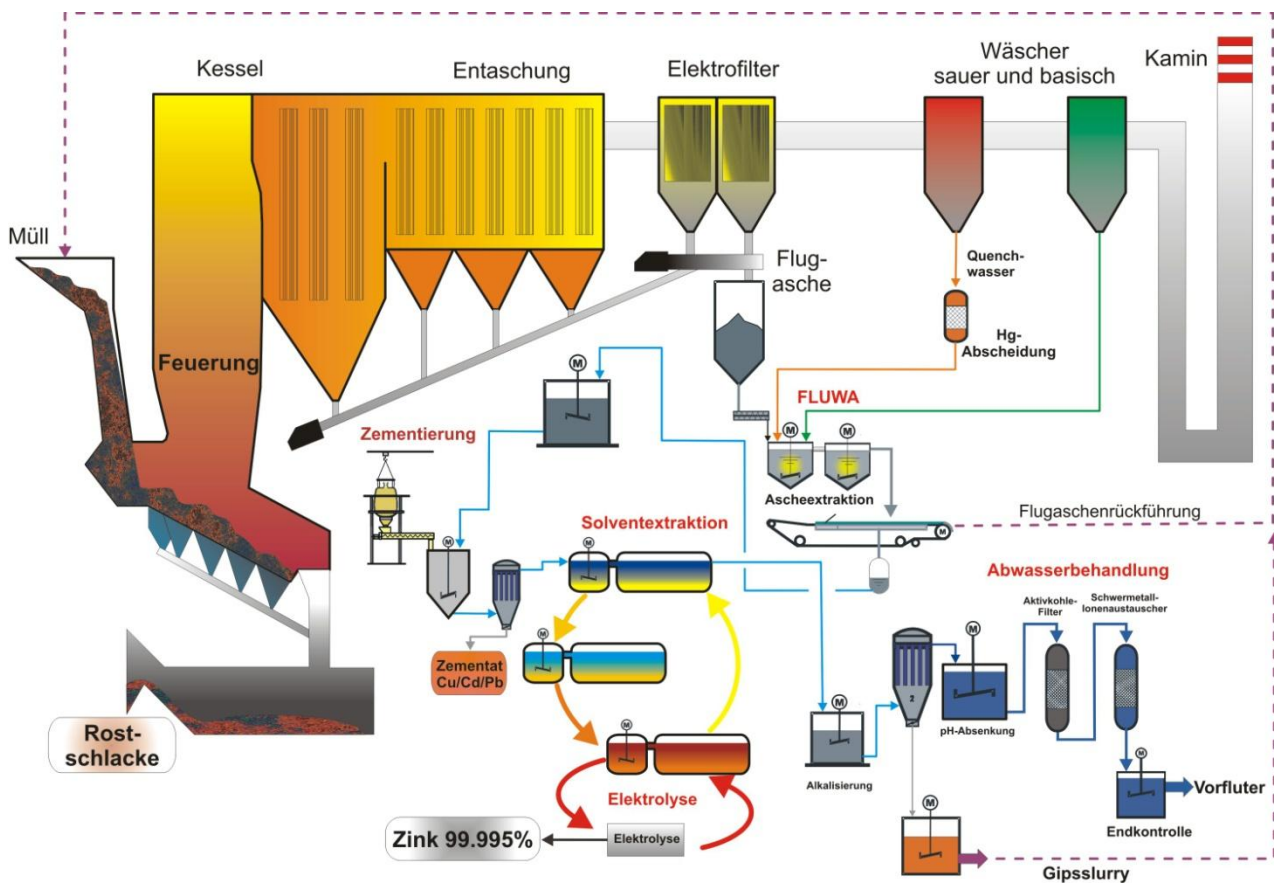
5% لم يحرق ولكن قابل للحرق و يعاد الى المحرقة

(مثل خشب، ورق، ثياب، ...)

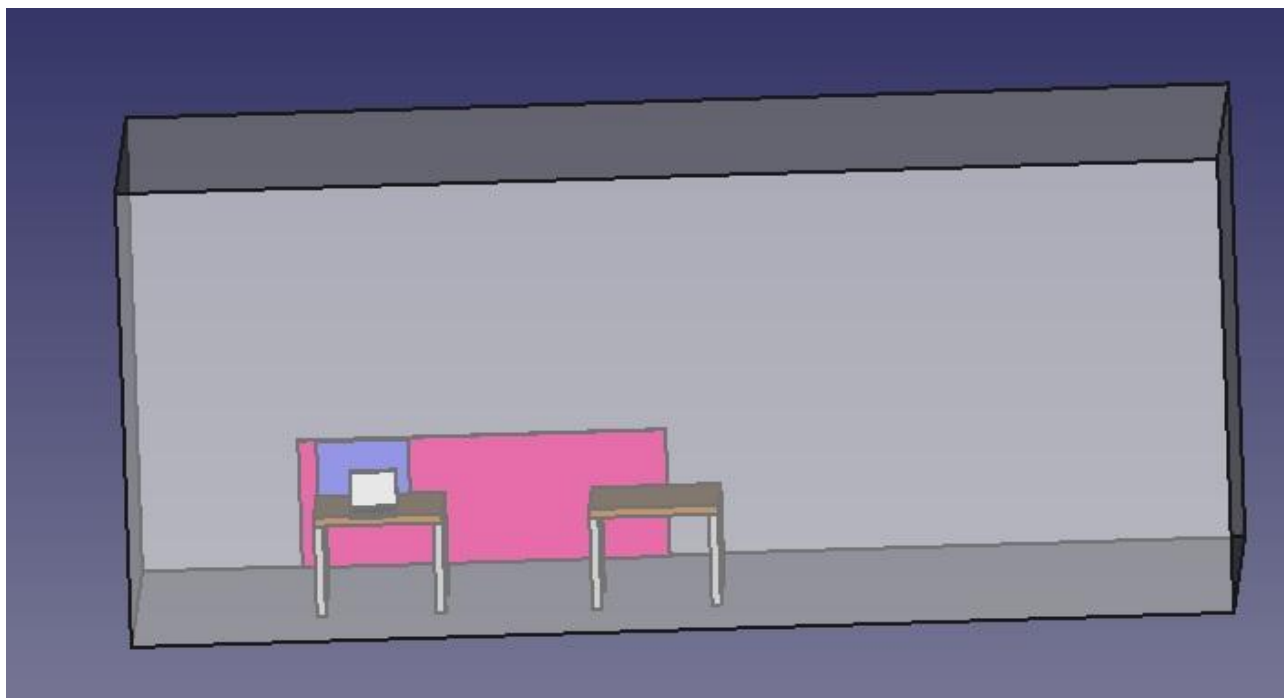
### Inhaltsstoffe von Rostaschen

- mineralische Fraktion 84%  
– Deponie, Wegebau –
- Fe- und NE-Metalle 11%  
– metallurgische Verwertung –
- Unverbranntes 5%  
– zurück in die MVA –

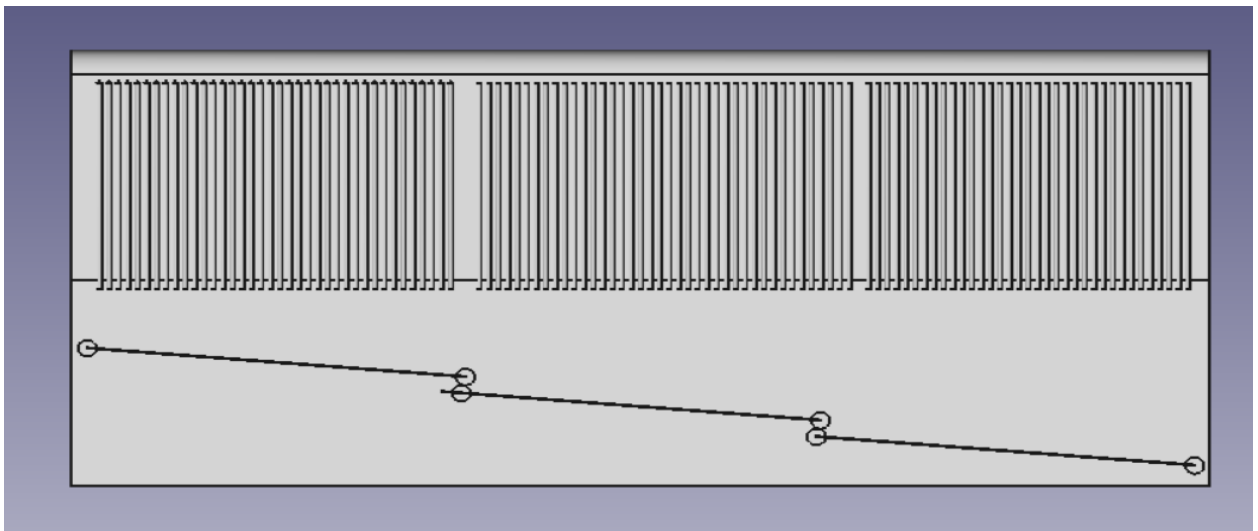
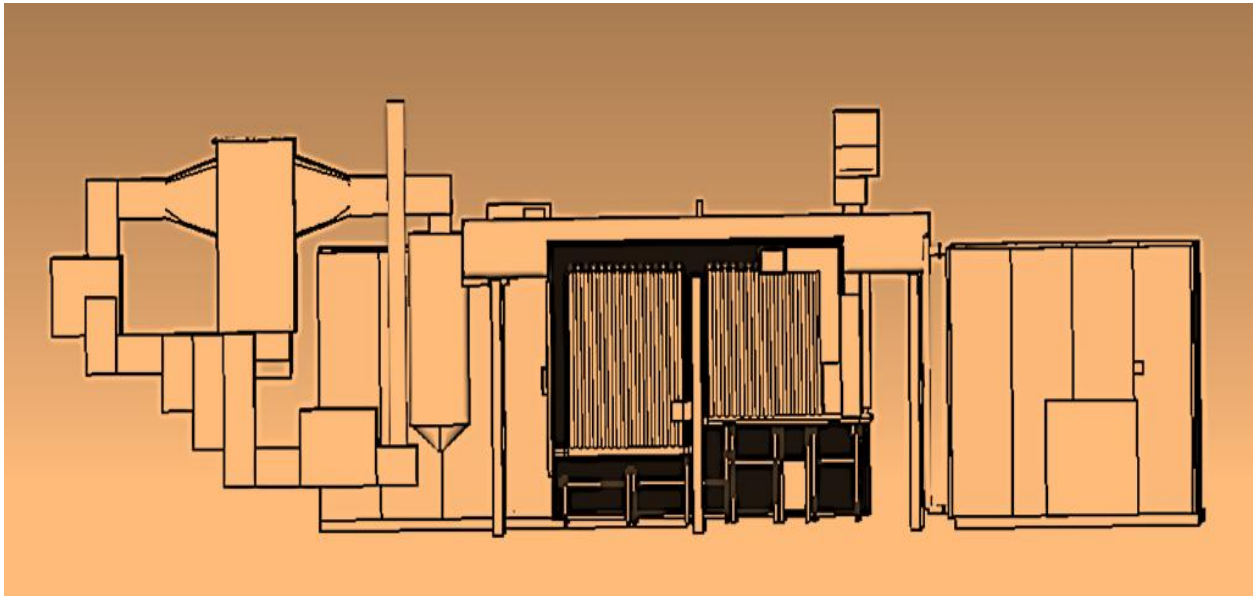
## FLUREC/FLUWA 11.2

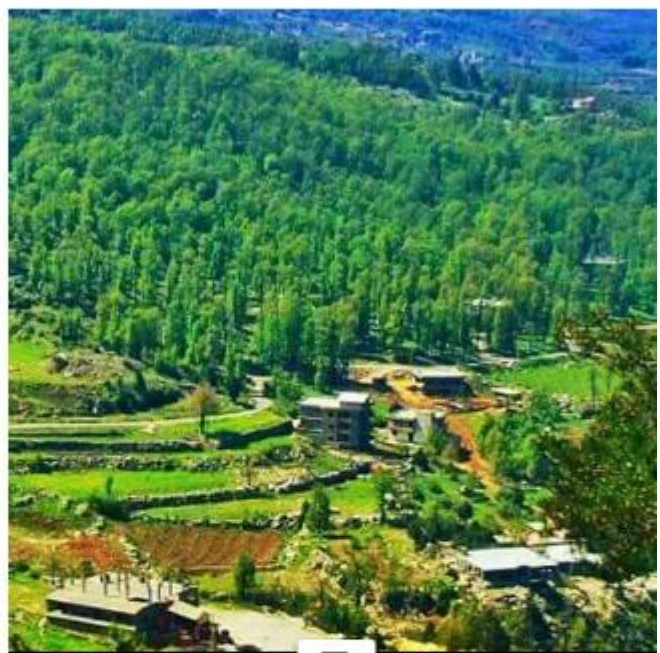


chemical ash recycling









نحتاج من البلدية مساحة ارض تساوي 500 متر مربع

**Installation cost (materials + project management):** 2 MW turbine and generator, pipes, pumps, filters exchanger, condenser about 3 million \$

الايجابيات



## Supplier 14

### 14.1 تصنيع قطع (...CNC)

Company	Phone number	Description	Address	E-mail web site
CNC LAB	06 412 895 03 476 916	Manufacture 3D design in plastic & open source hardware	Tripoli, Lebanon Bahsas, Behind Haykalieh Hospital, Harba Bld.	<a href="http://www.cnclab.com">www.cnclab.com</a> <a href="mailto:info@cnclablb.com">info@cnclablb.com</a>
Hasan Al Baba	03 828 256	Manufacture and casting	Tripoli, Lebanon Mina, Industry and Commerce street	
HI-Tech fabrication Fawaz Abdel Hadi	06 442 787 70 751 522	Precision mechanical parts manufacturing brass & steel marking heads maker	Tripoli, Lebanon Mahjar suhi P.O. Box 1274	<a href="http://www.hitechfabrication.com">www.hitechfabrication.com</a> <a href="mailto:info@hitechfabrication.com">info@hitechfabrication.com</a> <a href="mailto:sirfawaz@yahoo.com">sirfawaz@yahoo.com</a>
Hannuf mechanical 'Corporation for casting and art construction	06 387 723 03 717 107	Manufacture and casting	Tripoli, Lebanon Al Badawi	
GPS Steel	03 196 225	Uses electric discharge machining process to shape any metal material rapidly by using desired modeled electrodes	Beirut, Lebanon Burj Hammoud	<a href="mailto:Gps.steel.co@gmail.com">Gps.steel.co@gmail.com</a>
Riyako factory	79 118 779	3D CNC machine, manufacture cupboard for cars	Tripoli, Lebanon Badawi, behind Al Ridani bakery	

### 14.2 صب

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