AMI

Applied Microwave Industries

Representing

Dr. R. Parosa w/Aton HR

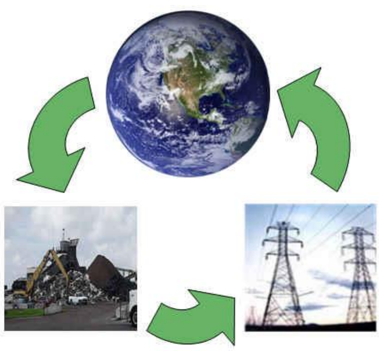
& BoldEco Environmental

The Treatment of Industrial Wastes for difficult material remediation.

RED WATER PROPOSAL

Process Block Diagrams showing

Step Descriptions, Mass Flows and Electrical usage.



Ft Myers, Florida

Many figures are still estimated from laboratory scale modeling, therefore the resulting per step details will be fine tuned once operational. This entire document is Company Proprietary Information, copying or using any parts is not allowed without company written permission. This disclosure on the title page covers the entire document.

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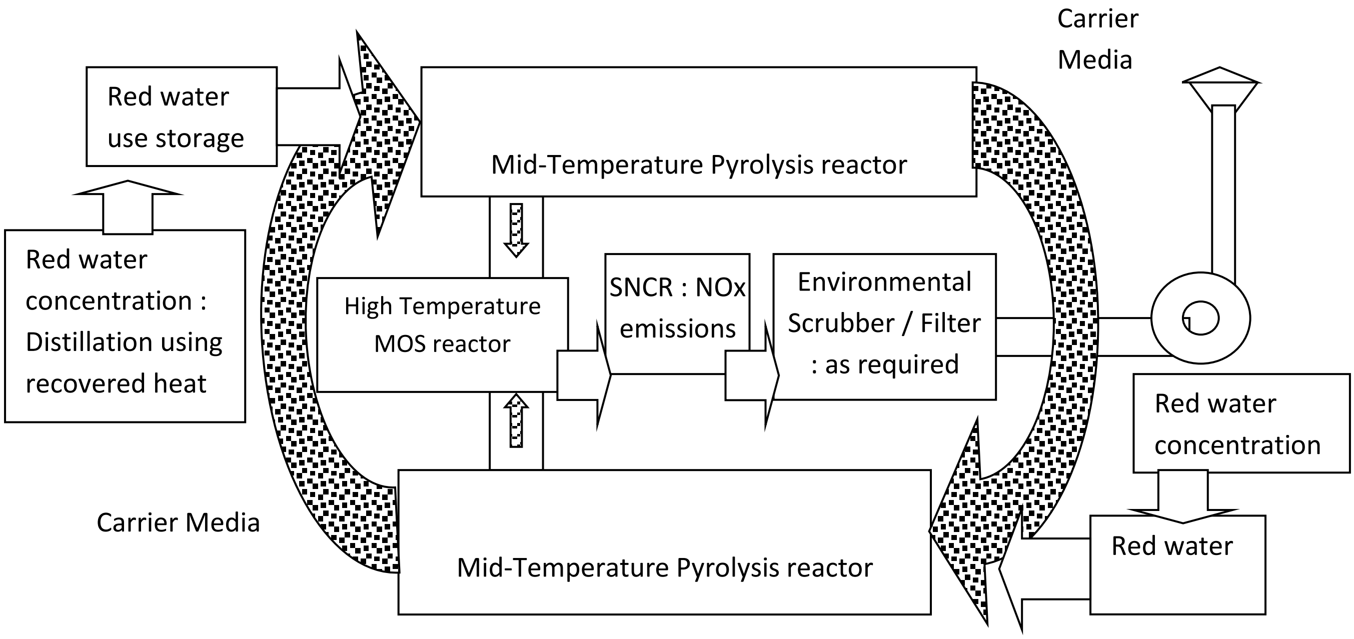
RED WATER DISPOSAL / DESTRUCTION PROJECT

Below is the proposed flow diagram for the destructive process flow. The process flow basics are 5 steps including preparation of the Red Water, introduction to the pyrolysis reactor, processing, gas high temperature destruction, environmental scrubbing (only as required) and output monitoring. Some key elements of this flow are the reuse of the carrier media as many as 20 times reducing solids output needing landfill, energy conservation, high temperature destruction with cooling to decrease by-product (dioxin) formations, and complete environmental scrubbing to full EU Standards.



Specific treatment of the gas and solids by-products of this processing technology is considered integral to the success of any installation. Combined reuse of energy flows and balances are also considered, many times uniquely, due to considerations concerning feed stocks, effluents, and process/equipment cost/design.

Excess nitrogen-containing gases will be reduced to nitrogen molecules utilizing SNCR at elevated temperatures.

HEAT RECOVERY USES

There are 3 points in the process that heat recovery will be used to significantly reduce the energy needs of the installation:

1) After the MOS / SNCR combination, the processed Hot Gases will be looped to the Carrier Media for preheating to about 800 - 900 C. With the mixing of ambient Red Water fluids at a 50 / 50 mix, this brings the input to the HR reactors to about 400 – 450C, the processing temperature. Minimal energy will then be used by the HR to complete processing. This is a savings of almost 100 kW-h of energy.

2) We will also pass the air needed in the HR over these gases pre-heating the inlet air requirements.

3) After the Heat Recovery step for media pre-heating, the gases will then be used with a thermal fluid recirculating system to give 325C hot fluid to the de-watering distillation systems which run under vacuum, therefore needing less energy to begin will, but this recirculating system will bring 75 kW of energy saving recovering heat from the process gas and not having to create steam.

These systems running under vacuum allow for the de-watering t occur at reduced temperatures which is much safer.

Key Technology

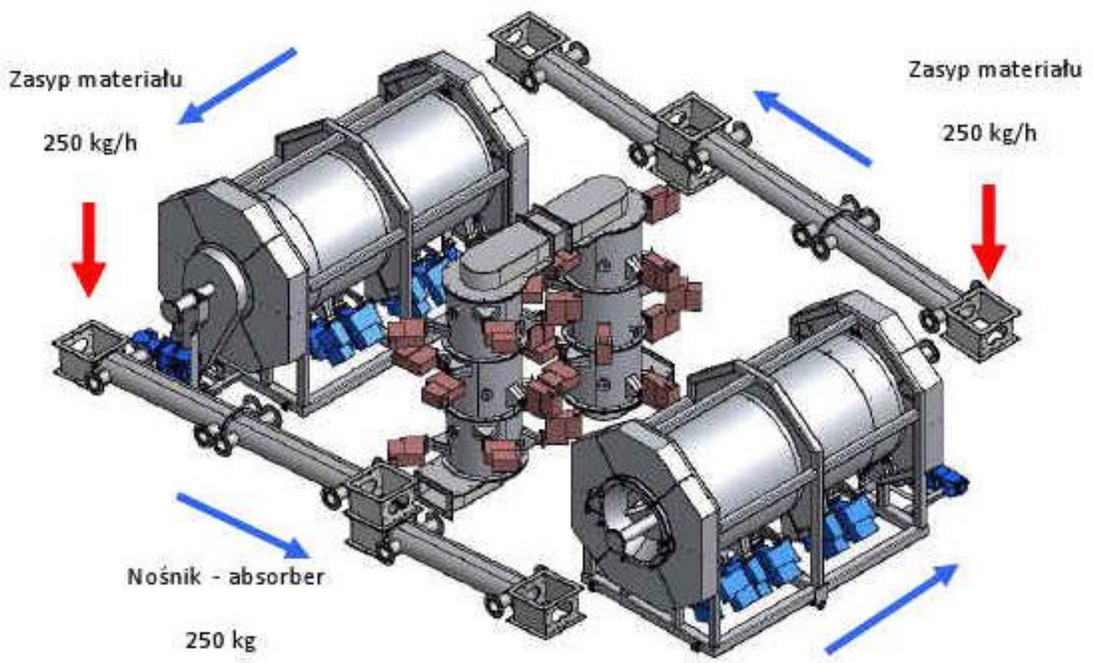
HR200 reactor technology is the keystone system for the controlled pyrolysis of wastes into energy-rich hydrocarbon product stream at about one thousand cubic meters of gas per hour. There are 3 major components; the carrier media input and red water injection into the rotating chamber, the reduction chamber where the majority of the gas formation and solids reduction occurs, and the dust removal and gas to cooling/scrubbing separation processes happen. The combined elements reduce all low energy salts and organics and other high energy density materials into a basic molecular gas stream suitable for higher temperature dissociation in the MOS.

Testing of the primary HR process with MOS completion showed no organics remaining and, other than NOx emissions that will addressed by SNCR remediation, the remaining gases pass EU regulated emissions. We already know the Red Water chemistry will have a near neutral pH between 6 and 8, and will be mostly salts solution with organics and very little if any acids. No chlorines are found from the client or from the lab results.

With MOS processing to molecular level gases, the temperatures are now near 1100 C and suitable for energy-free SNCR NOx reduction. This process step will simply inject ammonia across a catalyst surface causing the NOx to separate into nitrogen and water.

Since there are no acids generated in the MOS, with the exception of slight sulphur compounds, it is our onion that the sodium content of the process gas will combine with the sulphur to form sodium sulphate. This will deposit in the downstream areas of the MOS and require a periodic maintenance wash-down. Knowing this, the installation will not require scrubbing, but will be monitored during commissioning to insure this is so. If required, a small amount of activated carbon will be inject to being the sulphur emissions into regulation and a filter for particulate will finish the process.

All solids will be rinsed with water from the Red Water concentrating process and returned for extraction to the HR process.



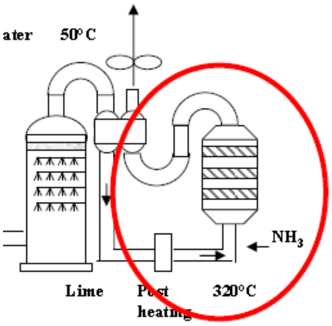
Dr. Parosa's High Energy Reuse circulation system with Absorbent Substrate (AS) recovery.

AMI Corp will be partnering with a very experienced vacuum distillation company to achieve water reduction to65- 67% of mass should be available from a system similar to this one shown here. A thermal fluid

Typical Heavy Waste Water concentration systems: Step One (Samsco & Metsco company references)
System capacities range from 300 to 4000 gals/day : about 60% water reduction maximum

Post-process cleansing environmental systems:
Our BoldEco partner is very experienced in delivering over-capacity systems addressing all the environmental concerns for existing and unique waste stream needs. In this case, an ammonia injection system will be used to cut the NOx emissions by at least half, and with this occurring after the high temperature MOS, will require zero energy to implement.

EXAMPLE of the SNCR
Due to the nature of the slurry chemistry, there is a lot of NOx gases generated, therefore this requires SCR or SNCR; Ammonia catalytic NOx reduction to nitrogen and water-oxygen. Within the red circle is the process key to NOx reductions. If required for SOx and other contaminates, a typical small footprint wet scrubber (left of the red circle) would be employed.



$$4NO + 4NH_3 + O_2 \xrightarrow{\text{Catalyst}} 4N_2 + 6H_2O$$

$$2NO_2 + 4NH_3 + O_2 \xrightarrow{\text{Catalyst}} 3N_2 + 6H_2O$$

- Metal
  - Pt
  - Pd, V, Zr…
- Inert support
  - Alumino silicate
  - Zeolites

CATALYTIC REDUCTION

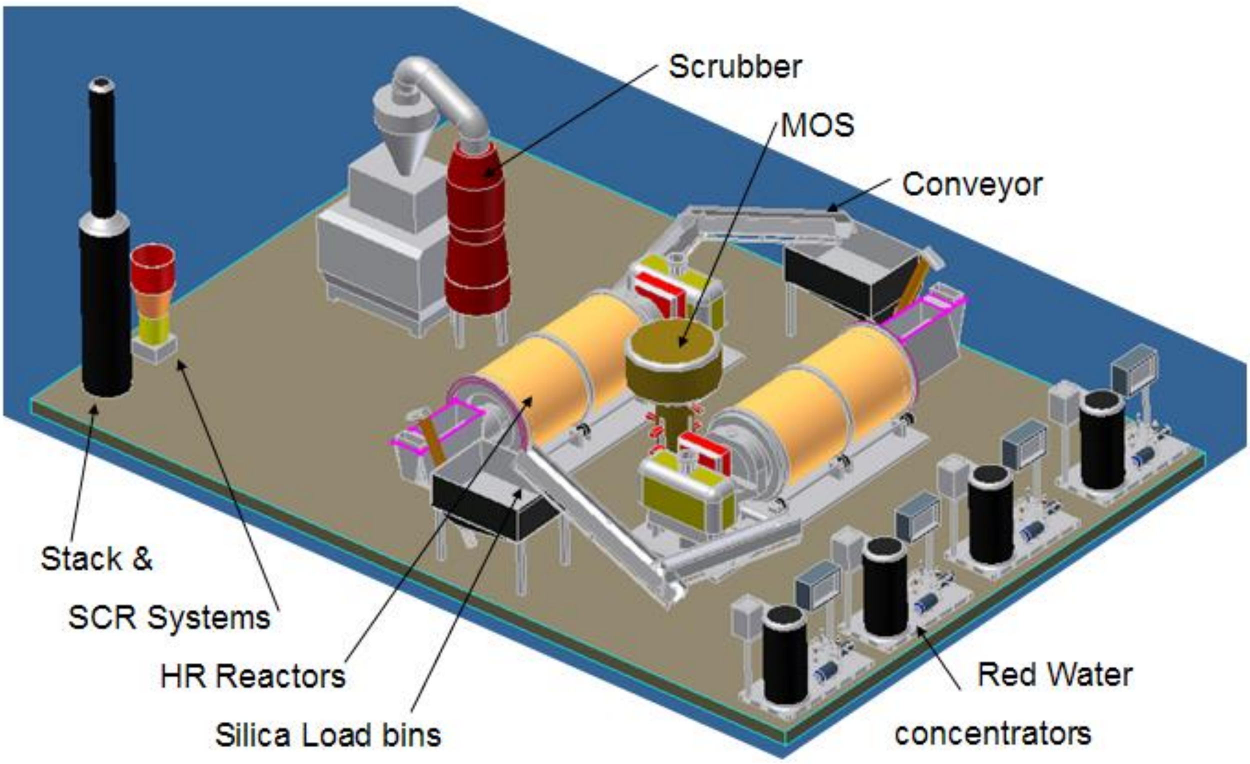
The Overview

Size; about 18 by 24 meters floor size allowing for work flow of materials around the HR reactors and the scrubber. A roof covering and removable walls will allow for all season operation. (System heat will be welcome in the winter, but need removal during the summers.) It is possible to only have one silica load bin, such that the conveyors always load into the reactor directly conserving heat. Reactor is equipped with two burners for fast preheating of ceramic elements (inside) before of operation for fast restart (about 2+ hours).

In this image where is a scrubber that is not seen as being needed.
We also show 4 distillation units, when new research has determined only 2 are needed, if obtained from the US.

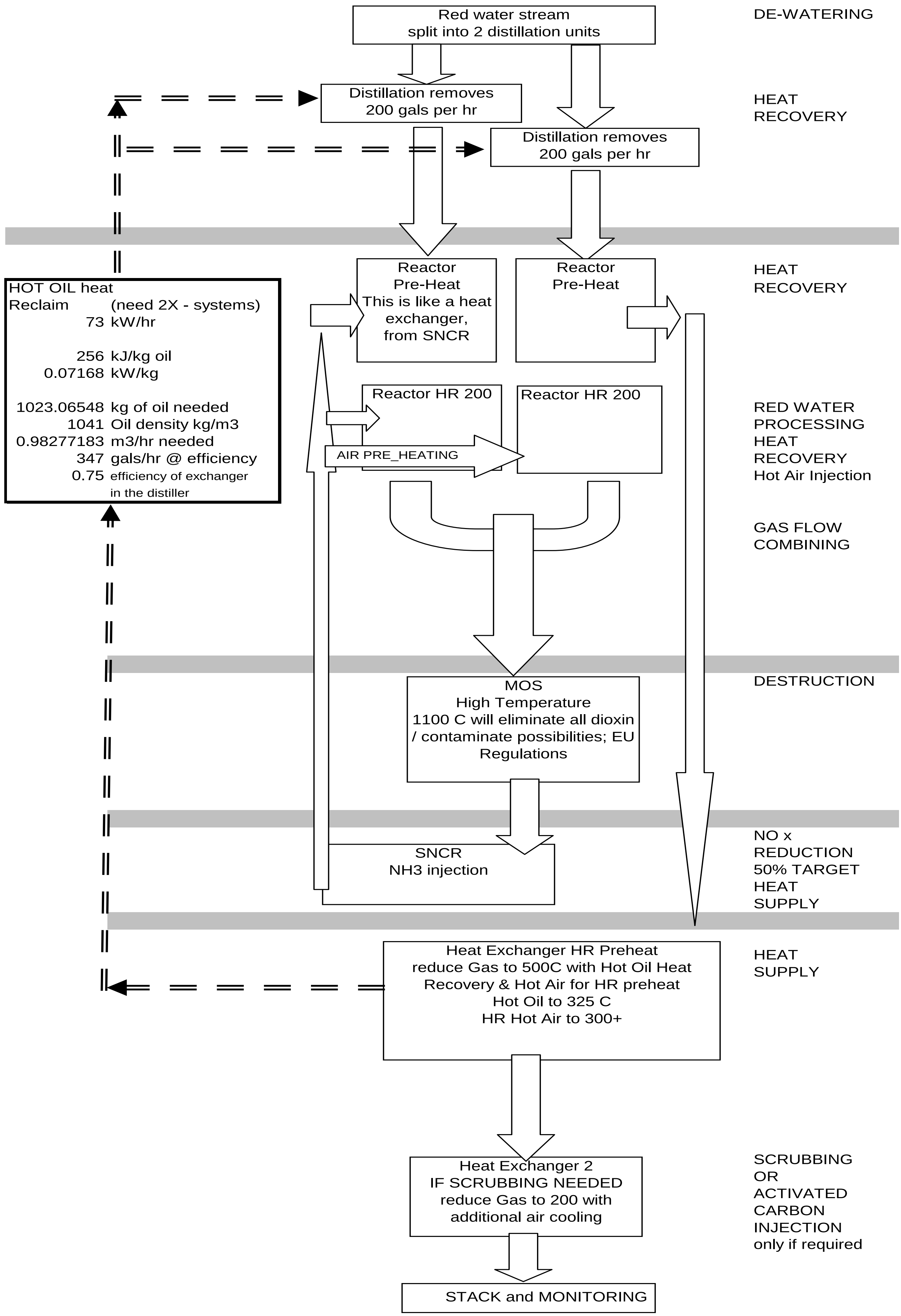
Not in this image is the SNCR unit, smaller than the scrubber, or the water cooling tower for the thermal fluid cooling.

The silica (carrier media) bins will be combined at the bottom of the up-sloping conveyors, and Red Water injection will occur at the loading section of the HR. Media pre-heating will also occur in these up-sloping conveyors.



HR 200 : Destructive Process potential layout

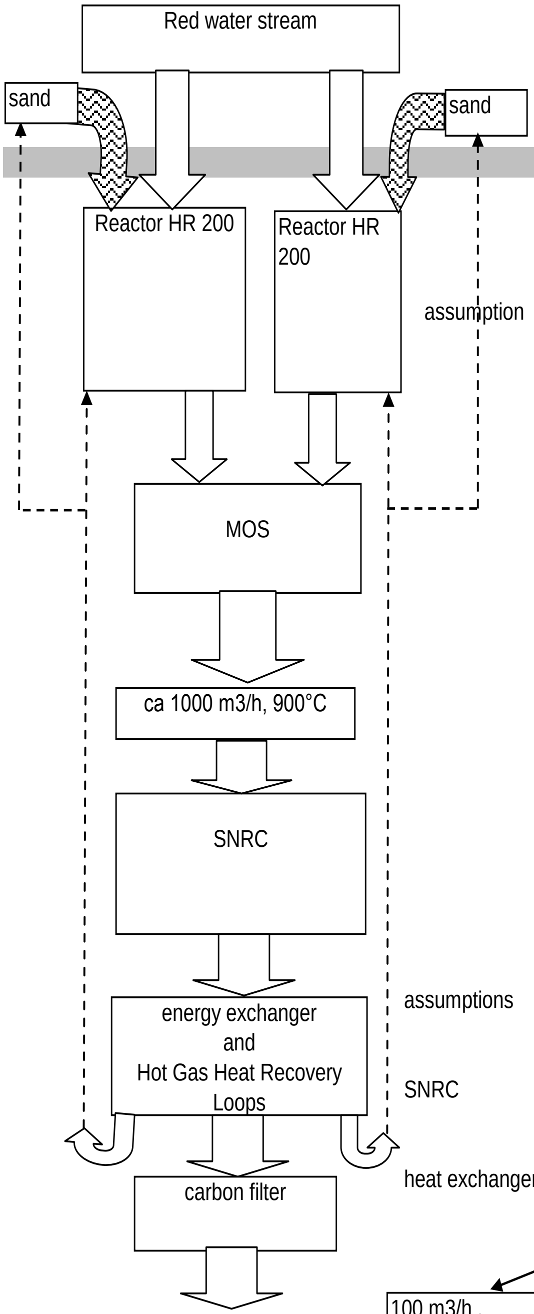
The process flow block diagram with step by step process descriptions.



FLOW BALANCES : Follows is a proposed operation mass flow. Any additional de-watering of the waste stream at the vacuum distillation (VD) step is a benefit to the entire process.

Version with red water after concentration (VD)

9.24	tons per day					
28.9	% of dry m.	2670.36	kg of dry mass per day	166.90	kg/hour	(average - 16 hours/day))
71.1	% of water	6569.64	kg of water per day	410.60	kg/hour	(average - 16 hours/day))
			Heat power for evaporation	285.14	kW	(teoretically)
				399.20	kW	(min)

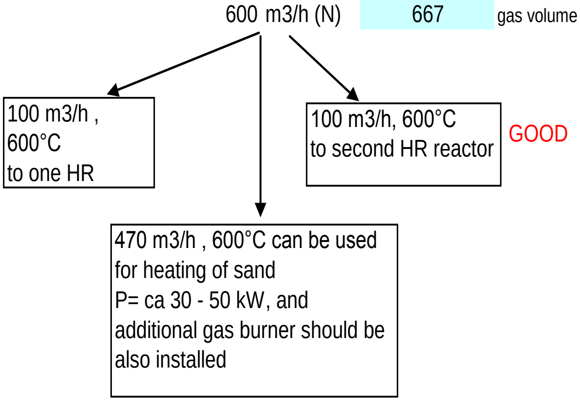


		sand		
	400	kg/hour		total weight of sand transported by 2 HR reactors
	800	°C	pre-heating	sand temperature (input of HR)
	x	°C		sand temperature when red water is injected (inside of HR)
assumption	90	°C	Distillation heated	
	249920	kJ		energy transfered from the sand to red water
	69.42	kW		
	0.0702	kW	Hot Air injection of 100 m3 air at 600C	
	166.90	kg of dry mass per hour		
	370.88	kW		heat power from burning process (8MJ/kg)
	72	kW		microwaves
	512.38	kW	power transported to the red water inside of HR reactors (from sand, microwaves and oxidation)	

Only addditional 70 - 80 kW is needed for heating of sand

In the estimations I do not include heat power from the heat exchanger (installed after SNCR)

	308.0	m3/h (N)		steam volume crossing each HR reactor
	133.5	m3/h (N)		gases from oxidation of solid particles in each HR reactor
	441.5	m3/h (N)		gas volume crossing each HR reactor
	882.9	m3/h (N)		total gas volume transported to MOS (we must install MOS reactor for min 1000 m3/h)
assumptions	1000	m3/h (N)		gas at the output of MOS
	900	°C		gas temperature
SNRC	700	°C		gas temperature after SNRC
	1000	m3/h (N)	778	gas cooling reduces volume
heat exchanger	600	°C		air+F11 temperature from heat exchanger
	600	m3/h (N)	667	gas volume from heat exchanger



OTHER ECONOMIC ANALYSIS

		Electricity		propane gas		replacement (spare parts) and utilities				
	Conversion PLN to US	3								
1	Sand transportation system 2 units mixing included?	5 kW	electric motors			sand	50 tons/year	78000	PLN/year	
2	Reactor HR 200 (2 units)	130 kW	90 kW of microwaves (magnetron -60% efficiency + wentilators, etc)	10 kg/hour	two gas burners	ceramic magnetrons other	 10 pcs/year	120,000 25000 5000	PLN/year PLN/year PLN/year	
3	Hot cyclon (2 pcs)	20 kW	max							
4	MOS reactor Does this include cooling water?	120 kW	about 90 kW of microwaves (magnetrons/power supply)			ceramic magnetrons other	 8 pcs/year	80,000 20000 5000	PLN/year PLN/year PLN/year	
5	SNRC scrubber	0.7 kW	Ducting Fan;			ammonia	$557/mnth	20052	PLN/yr	
						about 1 bottle/6.6days, 16 hr days, no weekends				
	Cooling Tower; Thermal Fluid	10 kW	Fans & Pumping			US price / K size bottle, $184				
						US				
6	Oil heter/ energy exchanger (if needed)	6 kW	Pump & Air fan	5 kg/hour						
7	Destillator	125 kW	75 kW heat recovered							
		50 kW pumping, etc.		Estimate 7.37	PLN/MWh					
	Total	341.7 kW 5467.2 kWh/day	 2460.24 PLN/day	15 kg/hour 240 kg/day	 22.75 PLN/day		Total:	255,000 980.77 61.30	PLN/year - Cost of replacement PLN/day PLN/tone	 days in year 260 16 hr days

Effificency: 42 tons/day (6,5% solid)   Total operation cost (without replacement) 66.365 PLN for treatment of 1 tone of red water
22.12 PLN/ton

Utilizing the above Balance;

Two ways to examine the costs; Cost per kg of Red Water wastes, or Cost per kg of TNT produced.

Operating per day = Manpower + Electrical + Gas + Silica + Ammonia + Equipment replacement = 4840 PLN, and 42,000 kg of waste per day = .12 / kg waste processed.

Considering Nitro Chem makes 30,000 kg per day; then .163 / kg TNT produced.

(This does not include other utilities noted below, site, buildings, equipment depreciation/cost per day, etc.)

(PLN / Day; manpower = 1000, LP gas = 23, Silica = 300, Ammonia = 77; TNT processed = 30,000 kg/day)

PLEASE NOTE, Aton Lab Report June 2010, page 45 notes cost of carbonization from material dried to 87% (and we will be drying to 67%, so even better) gives a cost of $500 US/tonne without consideration of equipment amortization, labour, etc. I believe it did include energy and silica.

Since Nitro Chem does get a special industrial electrical rate and labour rates are only estimated, these cost figures are just that, estimates only.   Polish Electrical rates of .141 Euro/kW; Source http://www.energy.eu/

EQUIPMENT LIST and COSTS (US $):

Vacuum distillation units; 2 – 200 gal/hr, 1 for each HR	$1,040,000
Holding Tanks & plumbing	$25,000
ATON HR reactors : 2 systems with mixer-loaders	
Including the MOS catalytic conversion	$900,000
Includes Software control system for HRs	
Conveying systems for hot silica; one load bin	$50,000
Cooling system; exchangers, Hot oil recirc., Air Cooler	$35,000
Water cooling tower	
SNCR to address high NOx removal with control system	
(if required, scrubber not in this price)	$325,000
Stack, Monitoring, organic catalytic convertor	$25,000
Site control system allowing for safety and monitoring	$25,000
Installation	
Electrical, plumbing, ducting 2/insulation, Etc	$150,000
Total	$2.58 M US

(Site, building, facilities, lifting equipment not included)

BENEFITS :

- 3 Heat Recovery opportunities reduce electrical and gas utilities significantly
- Distillation process reduces silica and HR reactor needs and sizing.
- Since one HR feeds the other, and the silica circles around in this flow, heat energy is conserved since once you get the silica hot, you want to keep it hot & heat recovery will do that.
- With lab analysis of the HR process and known input and output chemistries, the process flow balances need only details to be implementation of the production capable system.
- ADDITIONAL OPPORTUNITY : Recoverable heat distribution can be utilized in many ways; municipal sludge drying (then used as fuel), reducing winter heating costs, wood drying as needed, pre-heating &/or steam creation, your neighbours need heat, for example.
- Destruction of wastes will be nearly absolute, and resulting silica can be land-filled after 20 uses. Water is recycled and reused as possible, presenting a more complete 'cradle to grave' remediation.
- Adding slightly oversized environmental equipment up front, allows for future redundant systems creating additional contracting possibilities.

EQUIPMENT LIST and COSTS (US $): TBD upon review of the Scope of the process intent.
Hardware sizing will occur once flows, mass, and capabilities of the required outcomes are finalized.
Licensing and permitting are not well understood at this time.
Installation and commissioning of the facility overseas needs additional details before cost analysis is done.
Training of operations and maintenance staff needs definition.

Utilities needed;

- LP Gas for startup of HR
- Building or Roofing Cover with Control Stand/House
- Electrical (480 Volts, 350 kVA)
- Compressed gas; 6 atmospheres, 90 psig
- Water source for cooling, filling, and fire suppression plumbing
- Chilled Water if available on site

OPTIONAL WASTE HEAT RECOVERY SYSTEM:

OPTIONAL SYSTEM FOR SELF-POWERING (at steady state) AND GREAT PUBLIC RELATIONS

- Self-powering ORC (organic Rankin cycle) unit. So if not using internal combustion syn-gas engines for electrical generation, one way to capture some of the heat created with the destruction of the waste stream, we propose this OPTIONAL 100 kW generation method to power most of the needs of the site while under steady-state operation. This uses the waste heat generated after the Titov cooler and after the MOS to power a small turbine without any waste. This is a complete internal cycling system only needing cooling water, which we will have anyway.

  Sub-total $500,000/ea

- ***There is a 'lease to own' program for this***; Pay for the electricity it generates if it ran 'X' hours per day for 12 months, then ownership transfers. Calculations for this size of system need to be completed, but previous have shown show 10 to 11 month payoff at steady state. Plus expenses of start-up engineer.
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Statements of responsibility: This is a preliminary project statement from early studies of sub-system availability and first data from smaller scale demonstrations and laboratory experiments. Is not meant to express capabilities or volumes of output.

EU Air Emissions Calculations and Limits

Compounds Calculated

http://202.194.4.88:8080/wulihx/data/Conversions-and-Formulas.htm

							Gas Volume m3/hr N			
							250			EU
							KGs		240 day yr	Limits
Generated Compounds						Conversion rate	/ hr	/ day	/ yr	/ day avg
	Table 3.6.2		3.5.2	MW	mg/m3	in SNCR				
%	CO2	0.23	0.13	34	2501.574	85%	625.39	15009.45	3.60E+06	no limit
ppm	CO	0.7	3.97	28	2.672434		0.67	16.03	3848.30	100
ppm	NO	160.7	59.6	30	135.0728			Combine as NOX,		
ppm	NO2	6.5	0.02	46	6.129675					
ppm	NOx	167.2	59.6	46	213.2224	31.98 part remaining	8.00	191.90	46056.04	200
ppm	SO2	3.1	8.91	64	23.30879	5.83 Na conversion	1.46	34.96	8391.16	50
%	O2	20.85	20.85							
ppm	N2	167.2	59.6	28		110.3194	27.58	661.92	158859.98	no limit
ppm	H2O	1003.2	357.6	18		425.5178	106.38	2553.11	612745.63	no limit
ppm	NH3 slip	668.8	238.4	17		47.27976	11.82	283.68	68082.85	?
	NOx as NO2		59.62							

<u>Converting Atmospheric Pollutant Concentrations</u>: from ppmv to mg/m^3

The conversion factor depends on the temperature at which you want the conversion (usually about 20 to 25 degrees Centigrade).
At an ambient pressure of 1 atmosphere, the general equation is:

$$mg/m^3 = (ppmv)(12.187)(MW) / (273.15 + °C)$$

where:

mg/m^3 =	milligrams of gaseous pollutant per cubic meter of ambient air
ppmv =	ppm by volume (i.e., volume of gaseous pollutant per 10^6 volumes of ambient air)
MW =	molecular weight of the gaseous pollutant
°C =	ambient air temperature in degrees Centigrade

As an example, for gaseous pollutant NOx, convert 20 ppmv to mg/m^3 at 25 °C:

$$mg/m^3 = (20)(12.187)(46.01) / (273.15 + 25) = 37.6$$

where: 46.01 = molecular weight of NO_2 (i.e., NOx expressed as nitrogen dioxide)

NOTES:
(1) The pollution laws and regulations in the United States typically reference their pollutant limits to an ambient temperature of 20 to 25 °C as noted above. However, in other nations, the reference ambient temperature for pollutant limits may be 0 °C or other values.
(2) 1 percent by volume = 10,000 ppmv (i.e., parts per million by volume).
(3) For all practical purposes, degrees Centigrade and degrees Celsius are synonymous.