

ShwayComs : Kenta - pneumatic battery / capacitor for renewable source energy

Co2 recycle paradigm plant / carbon oxide decomposition paradigm plant :

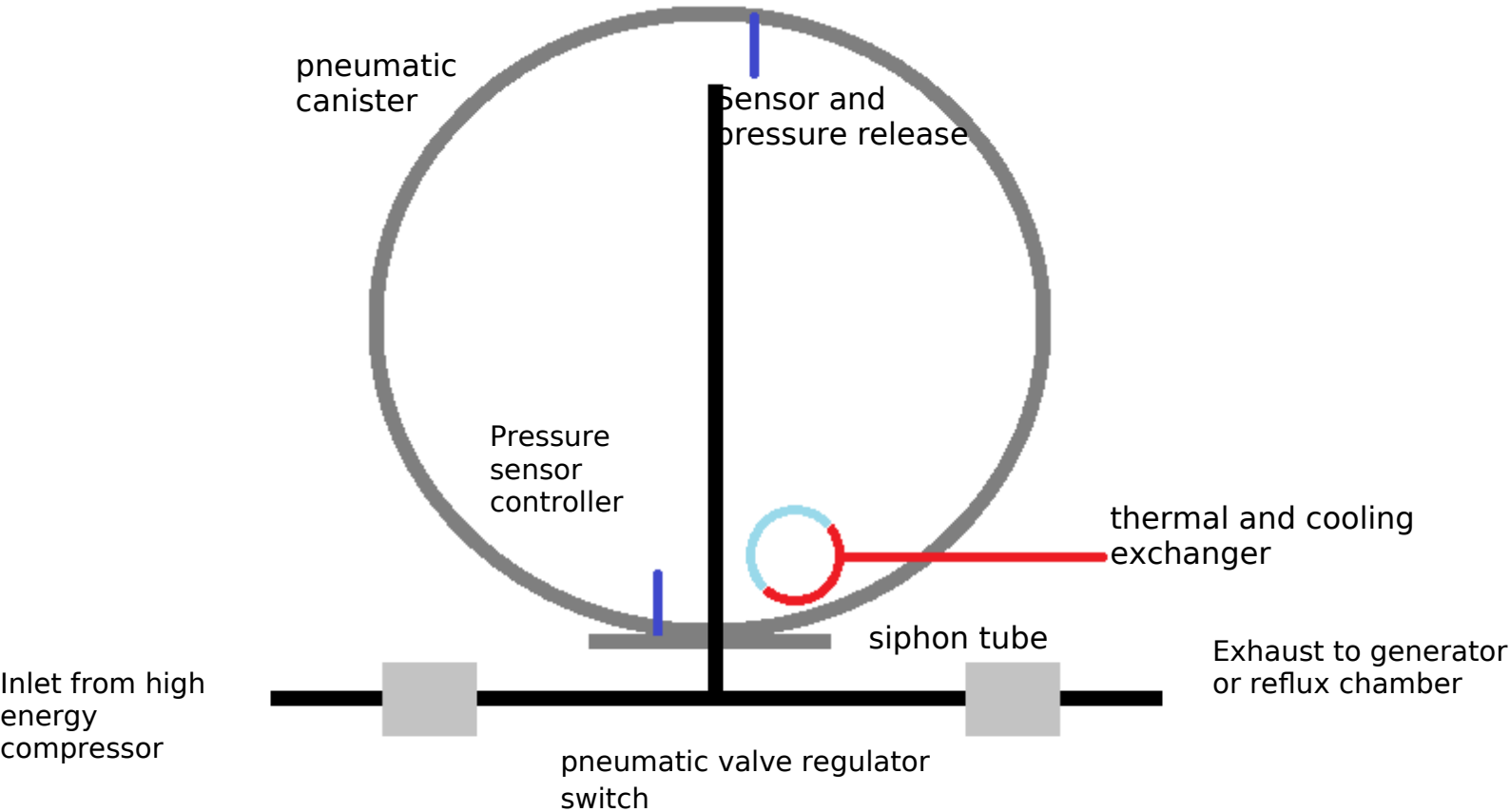
Brief : Kenta 4.4 SE PRV : 2100175-5 :

This document is a filing application by and covers a overview of ShwayComs pneumatic capacitor / battery is a energy conservation and storage technology optimization innovation. A Kenta is deployed as active capacitance energy storage by design and concept for variable source intermittent energy source as with wind turbine and solar panel PV as well as providing a utility for peak energy on demand management. A kenta plant allows for the capture and output of heat sources as electrical output complementing solar energy input adding to of energy which may be geothermal heat energy and or industrial waste heat from industrial process such as steel foundry waste from fossil fuel process. Proposal of Kenta is a recent development solution put forward with this patent resource. A pneumatic battery proposes a low maintenance solution with little corrosion collateral exposure housed units with reduced part count compared with conventional generator solutions with consumables. Utility providers can use this concept in remote from source energy outlets such as for example grid electric vehicle fast charge stations for automotive that place a high energy demand of infrastructure current throughput not available in many areas with pressure storage tanks and pneumatic generators. Thermal loop at pneumatic feed and active cooling at pneumatic release points pose greatest challenge of energy loss for variable energy input from solar or wind to a Kenta leveraged energy utility grid. Scaled to potential pneumatic compression technology from pneumatic battery can solve many of the short comings of variable source energy wind and solar through energy storage; a battery is used to regulate variable source energy delivery for improved consistency a reservoir of on demand energy for cloudy / summer rain functioning as backup unit for energy and storage power supply unit as typically functioned by a chemical batteries in current energy farms.

This document should be reviewed by a electrician and engineer for interpolation and assessment.

Kenta is a utility pneumatic storage battery for intermittent renewable sourced energy, solar, wind , grid renewable load balancing and is a suitable design for high capacity storage working environments as with a solar farm allowing a utility provider to store energy during the day for release at night or at requirement pattern demand as is a character of variable energy sources requiring load balancing. The production of methanol from solar energy source allows for seasonal storage patterns as well as transportation to markets far and wide for example production in the desert regions for consumption in high density urban setting. In order to produce methanol we produce a feed stock of hydrogen for selective COx synthesis of methanol.

4.4 utility storage Kenta battery



Controlled pneumatic valve switching from inlet to exhaust via the units siphon tube at two points could as well be achieved with a switched flow valve for one nozzle with dual purpose bi-directional with efficiency points. This unit has a pressure / proximity sensor controller meter that functions cutoff switching to the units compressor ensuring cutoff should a units canister fill to maximum capacity protecting this utility from overflow and empty operation. Prior to compression ; flue gas feed stock is radiated cooled to ambient or below temperatures to increase efficiency of compression.

Alkali metals such as calcium, potassium or sodium are selectively added to a kenta for augmented active sequestering with heat of aggressive trace elements over time such as acid compounds CO_x, nitric oxides NO_x from combustion and partial combustion capturing pollutants improving air quality in increment with even up to an approximate century equivalent of natural weathering in a 24 hour cycle for environmental control .

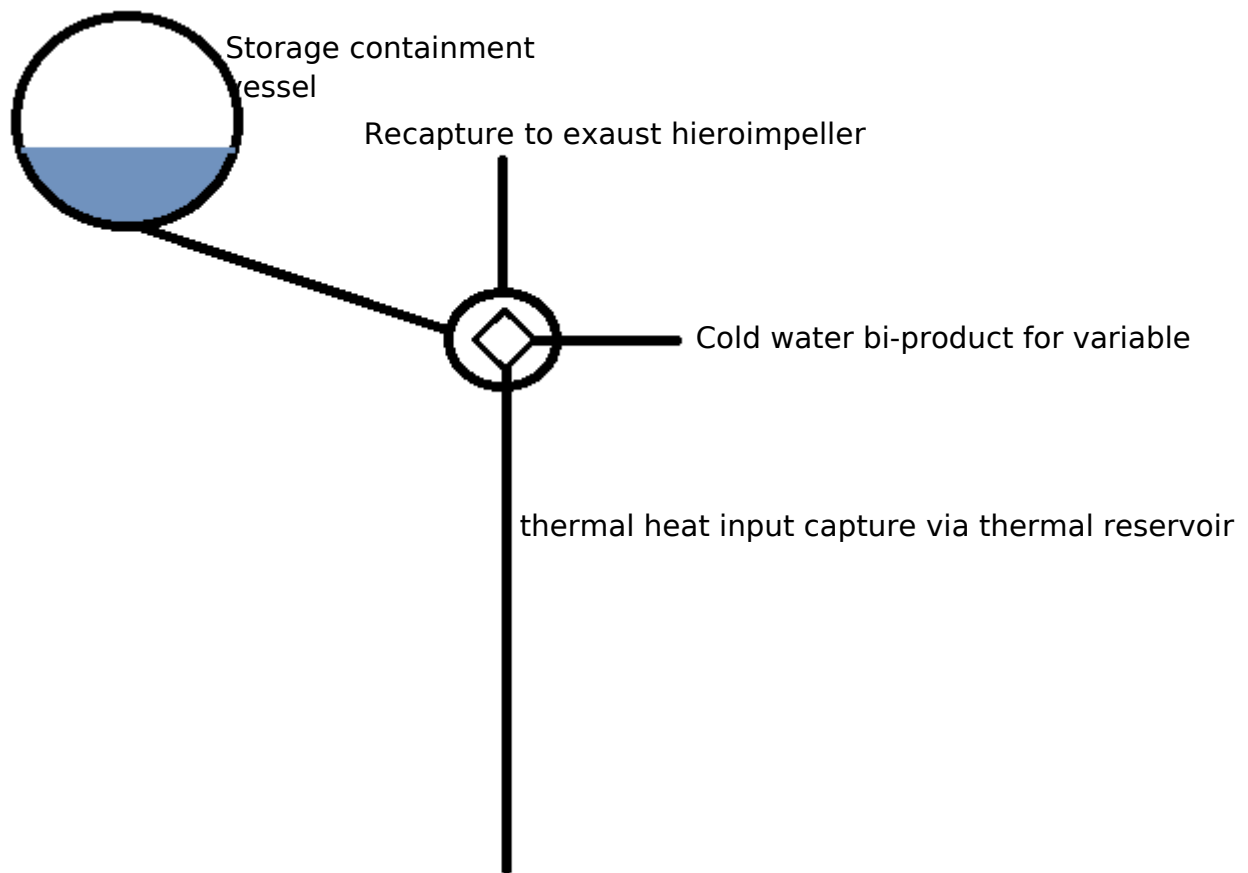
Waste heat thermal load energy element is used to maintain an optimized feed temperature on regeneration production of electricity and active gadolinium cooling of kenta feed or river water ambient cooling when required during sequestering and storage to realize feed temperatures below ambient; cooling is also achieved by boil off with loop back to compressors. A typical liquid air compression volume ratio is 700:1 so that every liter of compressed liquid air is ~700 liters of air. Waste energy from for example a coal fired power plant is recovered or from a steel foundry adding in significant energy Kenta can be in this way also be used to generate electrical energy output from geothermal heat not site dependent.

During the storage phase; waste heat is stored for use while re-flux generating electricity with compressed rest nitrogen N₂ feed stock; heat stored in thermal reservoir that can be complimented with available energetic cooling energy input from solar capture. These usages while consuming energy in themselves increase the systems global variable storage capacity while raising efficiency. At generation cycle phase transitioning of proves to play an important mechanical role in the active transport capture of waste compounds like CO_x and NO_x where multiple phase transitions (liquid / gas) play an

important role while maintaining temperature cycles above and below negative Celsius temperatures for hydrolysis and chemical capture while maintaining operating pressure for re-flux compressor injection to a re-flux chamber. Saline electrolysis estimated to be in range of 80% efficient producing hydrogen feed stock for the production of methanol from solar energy stores energy producing value add fuel . Geothermal thermal input control is used with a re-flux compressor for an optimal discharge balance of temperature and pressure; geothermal is a usable site independent wheat source input on generation of electricity complementing captured waste heat within the temperature range of geothermal for kenta feed stock as required.

Kenta is potentially a solution to the problem of global warming through thermal management directly converting excess heat into electricity at practical scale.

At point of generation discharge, a large scale Kenta plant variation employs a thermal reservoir for stored energy input to where more energy is realized than input solar energy from this units compressor complimented by thermal reservoir for net negative quota thermal plant value as energy inputs are from captured waste heat from industrial activity and optional geothermal heat pump as needed. A kenta power plant is a thermal absorption power plant – a kenta power plant drains heat thermal energy from any source converting the thermal energy into electricity. At generation liquid nitrogen is passed through a thermal reservoir via a bypass pipe of stored liquid nitrogen where it expands draining any thermal source to sub zero temperatures; a thermal reservoir can be a geothermal source, atmospheric source of thermal energy for example a thermal vent natural source of heat such as a hot spring or volcanic source can be drained of thermal energy to sub zero temperatures converting it's thermal energy to electricity. Kenta reflux liquid nitrogen expansion can drain thermal energy from ambient sources such as atmospheric or geothermal heat source. Volcanic vents or hot spring is a source of thermal energy for a kenta which converts present thermal energy into electricity the thermal source is left devoid of thermal energy at sub zero temperature which can be geological, atmospheric or industrial heat source reservoir.



Flue gas is gas exiting to the atmosphere via a flue, which is a pipe or channel for conveying exhaust gases from a fireplace, oven, furnace, boiler or steam generator. Often, the flue gas refers to the combustion exhaust gas produced at power plants. Its composition depends on what is being burned, but it will usually consist of mostly nitrogen derived from the combustion of air. Carbon dioxide (CO₂), and water vapor as well as excess oxygen (also derived from the combustion of air) further contains a small percentage of a number of pollutants, such as particulate matter (like soot aka black carbon) sequestered captured by wetting, carbon monoxide, nitrogen oxides, and sulfur oxides.

Most fossil fuels are combusted with ambient air (as differentiated from combustion with pure oxygen). Since ambient air contains about 79 volume percent gaseous nitrogen (N₂) which is essentially non-combustible, the largest part of the flue gas from most fossil-fuel

combustion is uncombusted nitrogen. Carbon dioxide (CO₂) CO_x, the next largest part of flue gas, can be as much as 10–25 volume percent or more of the flue gas.

An alternative to sodium is calcium hydroxide which we produce from calcium carbonate a carbon credit generating sequester compound. Flue gas is the gas exiting to the atmosphere via a flue, which is a pipe or channel for conveying exhaust gases from a fireplace, oven, furnace, boiler or steam generator. Quite often, the flue gas refers to the combustion exhaust gas produced at power plants. Its composition depends on what is being burned, it will usually consist of mostly nitrogen (typically more than two-thirds) derived from the combustion of air, carbon dioxide and monoxide.

Along with the sequester of noxious elements through sequester with hydroxide for nitric and sulfuric elements We isolate CO_x and store energy by selective catalytic synthesis of methanol using waste heat when needed for example from manufacture production plants which globally account for up to 8% of green house gas (ghg) released to the biosphere. A kenta plant produces hydrogen with source input from renewable source solar or wind for the production of methanol selectively isolating CO_x from manufacture process. Methanol stores energy conveniently as liquid compared to gas hydrogen storage and can be conveniently consumed either immediately with conventional combustion engine generation or seasonally consumed storage as indefinite. Methanol is produced with given on hand the required synthesis inputs of waste heat at 250°C, pressure, CO₂ and hydrogen; methanol is an alternative fuel for internal combustion engines that can be consumed as a fuel additive without alteration up to 3% in Europe. It is preferable to produce methanol for isolation of CO₂ in subsequent electricity generation which can then be sequestered thus initiating a sequester paradigm where CO_x is captured sequestered by diffusion in water with calcium suspension when consumed in production of electricity at an electricity generation plant. Sodium hydroxide and combination of CO_x can react to produce sodium carbonate a versatile solid successfully capturing CO_x from industry as with steel production. Electrolysis of sea water is estimated to be 80% efficient in store of energy to hydrogen is produced and is energy captured from renewable energy solar / wind and is therefore an efficient energy

storage and capture for methanol synthesis. Other acids are reacted with hydroxides comprised of various oxides emissions using sodium hydroxide or potassium hydroxide as neutralizing agent for value added products. Methanol is siphoned from a kenta vessel to storage tanks as it settles in the reactor as liquid.

Carbon monoxide , dioxide and hydrogen react over catalyst to produce methanol. Today, the most widely used catalyst is a mixture of copper and zinc oxides, supported on alumina, as first used by ICI in 1966. At 5–10 MPa (50–100 atm) and 250 °C (482 °F), the reaction is characterized by high selectivity (>99.8%):

Having isolated COx from the flue gas by selective capture producing methanol we look to isolating or releasing the rest of gasses present by boil off and phase transition siphon. It is preferable in most cases to isolate the various gasses in order to produce consistent specific reactor products such as specific fertilizers or instead a mixed ingredient fertilizer can be produced with a less complex bulk blended reaction with hydroxide a non specified fertilizer a white label high yield product. As gas is released from a liquid air 'flue gas' state nitrogen N2 isolate the order of release is based on the boiling off point of the various gasses.

Boiling points liquefaction:

nitrogen -196C

carbon monoxide -192C

oxygen -183C

nitrogen oxide -152C

carbon dioxide -79C sublimation solid

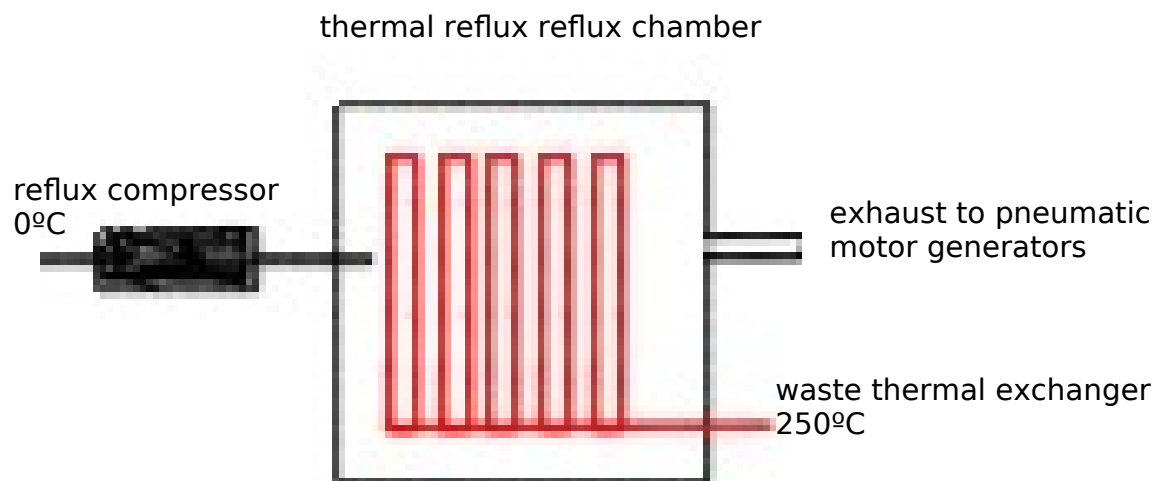
sulfur dioxide -10C

nitrogen dioxide 21C

As most of the gas present is nitrogen >79% this held in a liquid air state to be liquid air feed stock gas for power generation with pneumatic motors and generator set. Firstly in a boil off cooling process the first gas to liquefy for siphon is nitrogen dioxide at 21C. Next to liquefy for siphon is sulfur dioxide and so on by order of boiling point until we are left with just nitrogen as feed stock for thermal waste electricity generation. Having isolated COx with selective synthesis to methanol liquefaction we have only to cool by boil off (looping to compression) to -152C for liquefaction and siphon of nitrogen oxide and as this is the last remaining active acid reagent we can go ahead and add hydroxide to produce a fertilizer thereby only needing to cool down to -10C for the siphon of sulfur dioxide. This is a significant process energy saving having selectively sequestered COx through synthesis of methanol siphoned.

Hydroxides like sodium hydroxide , calcium hydroxide and potassium hydroxide are used to sequester and neutralize nitric oxide and nitrogen dioxide value adding creating fertilizers potassium nitrate. The creation of value add fertilizers generates income to pay for feed stock hydroxides. Sulfur dioxide when reacted with sodium hydroxide can for example produce value add as sodium sulfite. Additionally we can blend sulphur dioxide with water to produce sulphuric acid with a value ~\$420.

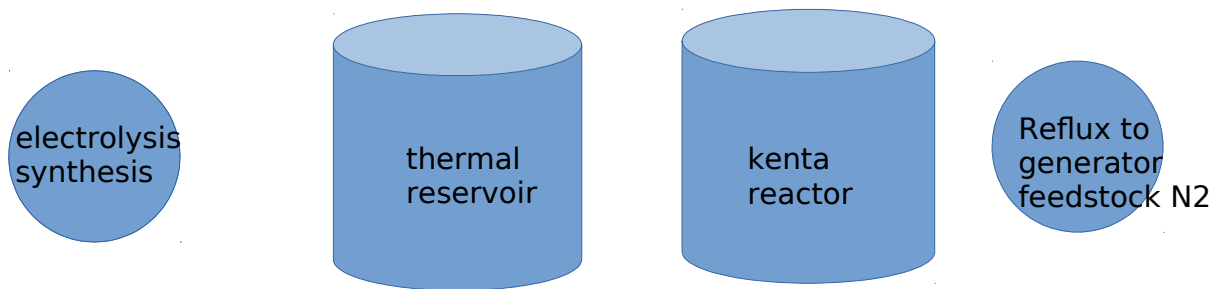
With Kenta 4.4 a thermal reservoir serves to capture, store and circulate thermal energy at a temperature stored in designated heat transfer fluid such as Therminol 68 at approximate 300°C - another heat transfer fluid medium being NaK (sodium potassium) which is then released to the kenta battery by heating element on generation re-flux. The thermal reservoir input is an isolated from storage liquefied exhaust tank and thermal reservoir tanks and adds energy into scaled fast feeder storage plants / cells for controlled generation and boil off / siphon.



With this module one has input of waste heat stored from a coal fired combustion exhaust which is recaptured energy typically at ~450°C giving this industrial scale variable energy storage solution a negative thermal value for environment advantage with waste material capture from coal or other combustion plant for renewable energy load balancing. Since this coal fired example installation is for one of the largest coal plants it is suggested to use several smaller tanks for example 8 kentans of 40 meter diameter each. Harvest capture of waste energy is significant and sequester of pollution is significant with the kenta. The reflux to generator pneumatic motor tank can be smaller than the kenta

reactor tank because it is built for extremely high pressures created by the input addition of waste heat energy which fuels high load set on pneumatic motors - this configuration allows for the capture of energy with a yield that includes thermal waste and is higher yield than the input of solar energy to battery alone.

The largest coal fired / incinerator plants burn ~1,200 tonnes of material hourly releasing ~3,500 tonnes CO_x hourly with an estimated release of ~8,500 m³ volume of exhaust feed material hourly when stored to a Kenta battery. Should this plant produce energy for twelve hours the plant produces ~115,000 m³ of exhaust gas when stored by a Kenta pneumatic battery in daily cycle. With these overview figures a Kenta volume of 250,000 m³ is required for operation with recapture of pollution waste at these coal operated plants and incinerator plants. A single spherical pneumatic Kenta with a diameter of 80 meters is sufficient for daily operation of this type of plant should one employ a single kenta at site; this and a thermal reservoir of the same size would comprise an installation of a kenta battery for renewable load balancing. Since this coal fired example installation is for one of the largest coal plants it is suggested to use several smaller tanks for example 8 kentas of 40 meter diameter each. Harvest capture of waste energy is significant and sequester of pollution is significant with the Kenta.



Process kenta work flow :

- A. Production synthesis by electrolysis of hydrogen for methanol feed stock.
- B. Yield synthesis for energy storage of methanol fuel capturing COx.
- C. Yield synthesis of products - fertilizers, bicarbonate etc potassium nitrite and sulfuric acid.
- D. Pneumatic motor generator set production of electricity from compressed rest liquid air nitrogen feed stock and waste thermal.
- E. Yield of fuel from methanol with capture of COx to recycle or sequester as calcium carbonate seawater and chalk.
- F. Decomposition revert of COx into constituents of carbon and oxygen by process of electrolyte electrolysis and boudouard reaction.

Hydrogen synthesis along with waste heat nitrogen pneumatic motor generation captures energy for storage with methanol synthesis while production of bulk fertilizers sequester waste emissions of nitrates and sulfurs also excess COx as carbonate which has many uses including as an industrial cleaning agent and household cleaning agent capturing

CO_x for sequester capture. These are products with high marketability and value such as for sequester in building materials; concrete and bricks to which we can add carbonate with a binder to successfully isolate and sequester carbon while lowering volume production costs; at the same time yielding a premium product. Methanol fuel has environmental impact when substituting for diesel in shipping as it is void of NO_x and SO_x to contaminate a marine environment.

Cycle 2 of Co₂ sequester optional

Cycle 2 of Co₂ sequester in a kenta vessel containing liquid state CO_x is by decomposition of CO_x using electrolysis. Electrolysis with copper as catalyst decomparts CO₂ to CO releasing oxygen and CO can be sequestered as acetic acid when CO is reacted with methanol to a stable value added product such as acetic acid. Acetic acid has commercial value as a food additive and an acid for use in industry. Acetic acid can be evaporated to sequester as a crystalline salt. Acetic acid can be used to make related products such as vinegar with another use being in production of vinyl acetate extending through to the production of polymers. We consider also CO has commercial value in industry for use as a fuel burning when exposed to oxygen to produce CO₂. Production of CO as a fuel may be of great economic revenue generation than production of methanol for use of energy to produce. CO has many industrial applications and carbon monoxide has a value of ~\$600 a tonne. As a fuel CO has an energy value of 2411 kcal/kg when compared with hydrogen at 33889 kcal/kg. CO can be reacted with water to release hydrogen fuel for economic value and has many industrial applications. Reduction of CO₂ to CO with Kenta process enters carbon into a recycle paradigm for use in industry to where Kentas can be used to capture and perpetuate a recycle chain for those industrial processes and applications.

Decomposition of carbon oxides optional

Decomposition of CO_x by the reaction, $2\text{CO} = \text{CO}_2 + \text{C}$, is catalyzed in presence of iron, the maximum deposit of carbon taking place at 550° C. We can then use electrolysis to decompose again CO₂ into CO in order to repeat the process decomposing CO_x into constituent materials with a yield of black carbon soot and oxygen. Carbon is deposited as a fine material for indefinite sequester reducing by half volume for each cycle. For liquid thermal transfer medium at this high temperature a reactor module employs NaK (sodium potassium alloy) which is liquid at ambient temperatures and a usable working heat transfer medium allowing for a temperature environment of 550° C. It is preferable to design a thermal reflux reaction chamber running a continuous cycle for throughput efficacy of a Boudouard reaction. Another apparatus to accomplish the decomposing of CO_x medium is to employ a catalytic converter converting CO to CO₂ at the same cycle stage as also CO_x electrolyte electrolysis liberating oxygen in process and decomposing CO_x to constituent.

Geological sequestration optional

Hydrolyzed CO₂ waste from operation some 140,000 m³ of waste can be pumped stored to deep porous strata bedrock for permanent sequester where we find elements in concentrate like calcium being one of the most abundant minerals of the earth; we can use river water hydrolysis transport where we have alkali strata such as porous alkali basalt which reacts with the waste to form for example carbonate compounds in the rock strata for on site sequester. With many layers of strata to choose from each having unique character we expect to find suitable strata at any plant site since transport of waste materials needs to be kept to a minimum given an olympic size pool of material is 2,500 m³ of material and we have a daily volume of ~115,000 m³ of waste to dispose of at the larger coal fired plants of the world. Using Kenta 4.4 one can expect to sequester >80% of pollution waste and 100% of particulate pollution. Given that coal fired plants have a thermal conversion efficiency of ~40% there is ~3,500 MWe .. 4,500 MWe of waste energy to be recaptured daily at these larger installations which solves for financing of waste disposal with sequester.

COx limestone sanitation optional

A method commensurate with localized sequestration using crushed rock crushed for granules is an inexpensive sanitation method of COx. Calcium carbonate is an abundant material in the earth's crust which in purest raw form are remains of ancient coral reefs a fossil remnant. While calcium carbonate denotes that the material is already carbonized; limestone dissolves away in solution by carbon dioxide reaction. Reaction with granulated calcium carbonate for sanitation of COx is effective sequester of COx and may be our least cost method option of sanitation disposal. Calcium carbonate stone (limestone) is granulated for increased surface area reaction in a kenta pressurized heated environment effectively speeding up reaction times to within a manageable time frame for liquid carbon dioxide. Since carbon monoxide has a balance neutral pH and does not react with limestone CaCO_3 we run it through a catalytic converter which converts monoxide to dioxide. Calcium carbonate as chalk is disposed of generally as a salt seawater with this being common makeup of ordinary seawater. Chalk also being a commodity can be stockpiled or sold.

Claims:

This type of energy storage battery with product yields and CO_x recycle plant for renewable variable storage; load balancing portability including proposed modes of employ does not exist; I am the originator of design and proposal concepts put forward here in suit of recognition and seeking to make this available for use in energy mix for variable sourced energy currently limited to chemical battery storage. This technology is warranted and necessary for the transition period from centralized energy to a decentralized renewable energy mix. Presented here is usage covering an introduction of application as well as elaborated proposal of use in energy transfer methodology.

Kenta can be used for base load pattern necessary grid and infrastructure capacity with downtime allowing functionality service in variable source energy solutions where previously a greater capital investment in source would have been necessary. Functioning as a battery / capacitor supports low loss retention rating of energy storage potential. Kenta batteries / capacitors can be in large utility networked plant design with for example a dozen large units at any capacity tanks with up to a million m³ capacity unlimited. Kenta batteries / reactors can also be in a grid network in tandem operation for solar farms close to created demand reducing grid workload as a base load balancing solution.

The kenta solution is flexible and complete meaning that we can for example capture in complete all of the discharge emissions from manufacturing in one case a steel plant sequestering all emissions profitably producing value added products like fertilizers , methanol and carbonates. On spot check from advertised feed stock and product we find that raw materials of sodium hydroxide to cost \$300 per tonne and product fertilizer being one of our products with a value of \$700 and this is a bulk up reaction so that a tonne of sodium hydroxide will bind with waste NO_x to produce upwards of two tonnes of product fertilizer or sodium carbonate a very versatile product. The more interesting fertilizer that we produce is sodium hydroxide at \$300 tonne reacted with No_x producing sodium nitrate retailing at >\$650 a tonne we would be able to choose hydroxide to create

valuable bulk up fertilizers like for example potassium nitrate worth closer to \$1,250 per tonne notwithstanding that for every tonne of input potassium hydroxide we have a yield of closer in excess of two tonnes of fertilizer. Another product in the kenta phase one of production kenta 4.4 is methanol which is the result of kenta battery worth \$2 a litre when sold as petrol additive. Methanol production using produced hydrogen is storage of renewable energy with as high as 80% efficiency. Production of hydrogen to synthesize methanol in a kenta reactor for transportation to market and use when most applicable for example seasonally. This means that it can make sense to locate steel production for example closer to the high sunshine regions where we can produce solar energy cost effectively in order to store as methanol with phase one of a kenta 4.4. all in all from phases one and two of a kenta plant we consume solar energy, waste heat from steel production and hydroxides while producing methanol, pneumatic motor generator set produced electricity, sodium carbonate and fertilizers also generating carbon credits \$30 - \$40 a tonne CO₂ having completely neutralized sequestered emissions of in one case a steel production plant. Using both phases of kenta 1.1 and kenta 4.4 we find that we can profitably operate producing products while consuming ghg emissions of a steel refinery or manufacturing plant. Steel production and cement manufacture account for up to eight percent of green house industrial emissions sulfur and nitrate emissions SO_x and NO_x pollution and of course CO plus CO₂ emissions monoxide - dioxide emissions. We can power industry with clean coal as is the case in many economies and when implemented with kenta 1.1 and 4.4 two phases of an industrial complex optimization plant we in fact have what is described as clean coal synergy adding energy of coal and solar generating income from energy storage and having value add product yield. Ideal net zero fuel usage of methanol is touted to be as a shipping fuel as it is absent of NO_x and SO_x pollutants.

Proposed yields including carbonate production to sequester indefinitely. Calcium carbonate is also a value added product ; a product sold as raw material in manufacture of cement. A kenta energy plant is for the recapture storage and production (waste heat) of electricity; methanol is produced as a store of energy from renewable sources (solar) for short to long term ; waste heat compliments nitrogen liquid air to produce

electricity using pneumatic motors ; in short term per 24 hour load balancing cycle, day storage for nightly release for example or production add value of hydrogen which is explosive alternatively as liquid methanol fuel.

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