Cycle de rankine exercice corrigé pdf descargar en

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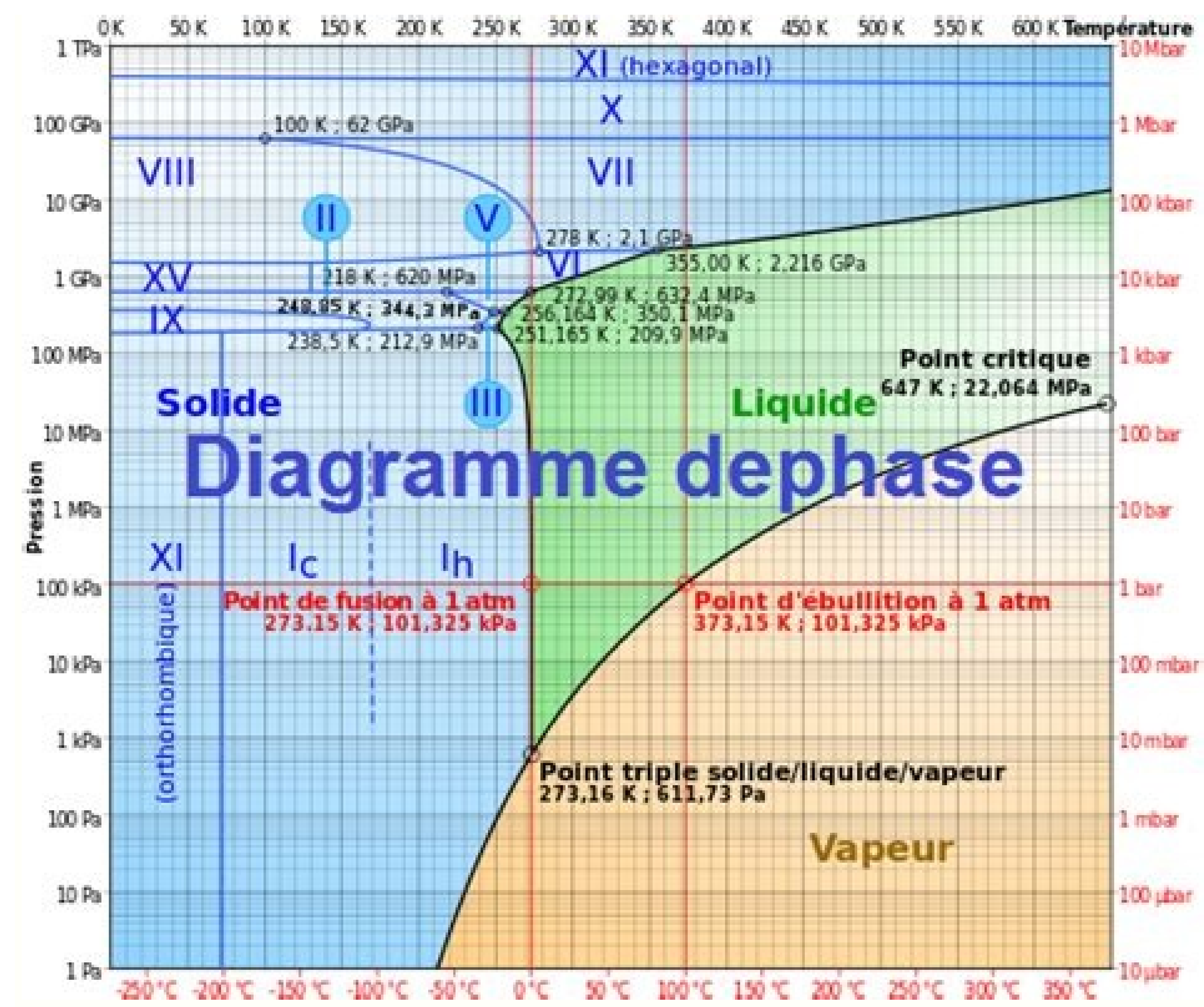


LV344 – Physiologie des grandes fonctions
Corrigé du TD de physiologie rénale

Exercice 1

Lors d'une exploration fonctionnelle chez un rat témoin normal, on effectue une perfusion intraveineuse d'inuline et d'acide para-aminohippurique (PAH). Après avoir recueilli les échantillons de sang et d'urine, les paramètres suivants ont été mesurés :

Débit urinaire = 10 µl.min^{-1}, $[inuline]_{urine}/[inuline]_{plasma}$ = 100, $[PAH]_{urine}/[PAH]_{plasma}$ = 600.

Calculer le débit de filtration glomérulaire et le débit plasmatique rénal.

Correction

Calcul du DFG :
DFG = $(U/P)_{Inuline}$ x V_u
DFG = 1 ml.min^{-1}.

Calcul du débit plasmatique rénal (DPR) :
Le PAH est une molécule exogène de petite taille qui traverse librement le filtre glomérulaire. Elle a en plus la propriété d'être excrétée par les cellules du tubule contourné proximal. Ainsi, le plasma artériel qui arrive au rein est pratiquement totalement épuré du PAH en un seul passage, si bien que la concentration du PAH quittant le rein par voie veineuse est environ 10 fois plus faible. On peut donc raisonnablement estimer le débit plasmatique rénal (DPR) en mesurant la clairance du PAH. Soit Q_E la quantité de PAH entrant dans le rein par le plasma artériel par unité de temps, Q_V la quantité de PAH sortant du rein par le plasma veineux par unité de temps, Q_U la quantité de PAH excrétée par unité de temps dans les urines, V_v le débit du plasma veineux et V_u le débit urinaire.

On a $Q_E = Q_V + Q_U$
$[PAH]_{plasma\ artériel}$ x DPR = ($[PAH]_{plasma\ veineux}$ x V_v) + ($[PAH]_{urine}$ x V_u)

On peut négliger $[PAH]_{plasma\ veineux}$. On a alors :
$[PAH]_{plasma\ artériel}$ x DPR = $[PAH]_{urine}$ x V_u

Donc DPR = ($[PAH]_{urine}$ x V_u) / $[PAH]_{plasma\ artériel}$
DPR = $(U/P)_{PAH}$ x V_u
DPR = 6 ml.min^{-1}.

Exercice 2

a) *En vue d'analyser, chez un chien, les modalités de l'excrétion de deux substances A et B, on a recueilli les données suivantes :*

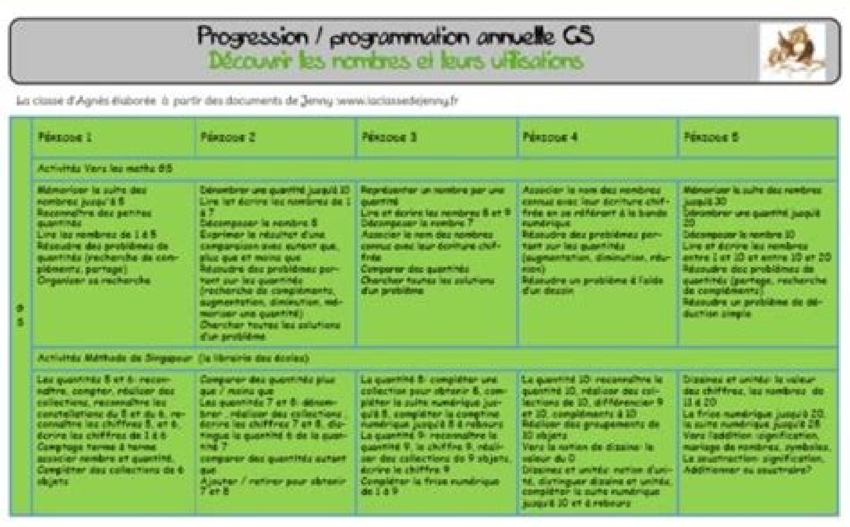
	Concentration plasmatique en mg.ml^{-1}	*Concentration urinaire en mg.ml^{-1}*
Inuline	*200*	*4400*
Substance A	*0,5*	*11*
Substance B	*2*	*132*

(30 ml d'urine sont recueillis par période de 10 minutes)

Quelles conclusions peut-on dégager concernant l'excrétion des substances A et B ?

b) *L'expérience a été poursuivie en faisant varier les concentrations plasmatiques de la substance B. Les résultats obtenus sont reportés dans le tableau suivant :*

Concentration plasmatique de B en mg.ml^{-1}	*Concentration urinaire de B en mg.ml^{-1}*
15	*990*



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Open Accessfeature Paperreview Department of Flow, Heat and Combustion Mechanics, Ghent University "Ugent, Sint-Pietersnieuwstraat 41, 9000 Gent, Belgium Flanders Make, The Strategic Research Center for the Manufacturing Industry, 3920 Lommel, Belgium Department of Natural Resources and Agricultural , Agricultural University of Athens, I would like 75, 11855 Athens Appl. Sci. 2019, 9 (12,) 2571; Received: May 21, 2019/Revised: June 14, 2019/Accepted: June 17, 2019/Published: June 25 cycle in several thermodynamic systems. This document is a review of experimental investigations on supercrytic operations taking into account both heat to heat and power to power systems. Experimental works are reported and then analyzed. The main findings can be summarized as: Rankine steam cycles does not show many studies in the literature, Organic transcrotic cycles Rankine are intensely investigated and few plants are already in line, the carbon dioxide is considered a promising slope to closed cycles for closed cycles Brayton and Rankine, but their the only properties require a new thought in the cycle components design. Transcromal heat pumps are widely used in domestic and industrial applications, but supercrytic heat pumps with a work fluid other than CO2 are scarce. Increase the adoption rate of supercrytic thermodynamic systems I don't know. ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪ ♪♪♪ ♪♪ omoc 2OC ed oilpma osu le ne sedatlucifid norasuac satla yum otneimanoicnuf ed senoiserp saL .orurolclitem y erfuza ed odix³Ãid ,ocaÃnoma ,ret©Ã neyulcni soipicnirp a norazilitu es euq setnaregirfer sorto ed solpmejE .n³Ãicaregirfer al arap elbaiv etnemlaicremoc ropav ed n³Ãiserpmoc ed ametsis nu ne norazilitu es euq setnaregirfer soremirp sol ed onu euF .n³Ãicaregirfer y n³Ãiccafelac ed senoicacilpa ne azilitu es euq larutan etnaregirfer nu se 2OC .rolac ed abmob ed aÃgoloncet al ed osu le noc rolac ed n³Ãicazilautca al se etnaseretni n³Ãicacilpa artO .odarg ojab ed rolac odnazilitu 2OC ed socitÃrcsnart solcic ne n³Ãicagitsevni s¡Ãm otsiv nah setneicer sopmeit soL .oveun etnemavitaler se dadilac ajab ed sohcesed ed rolac ed olcic nu ed oelpme le ,etneiugisnoc rop ,y rolac ed etneuf omoc raelcun rotcaer nu noc olcic nu ne odartnec nah es soidutse sol ed aÃroyam al ,etnatsbo oN .amet le ne odavoner s©Ãretni le ,0991 ed oineced le ne selairetam y sotcapmoc rolac ed serodaibmacretni ed ollorrased le sarT .sadauceda rolac ed setneuf ed adatimil daditnac al a odibed etnemlapicnirp odicuder ah es amet le ne s©Ãretni lE .olcic led senoicarugifnoc selbisop y socir³Ãet sotnemadnuf sol odnatneserp s©Ãretni le noraicini]01,9[reheF y onilegnA orep ,04 so±Ãa sol ed selanif a osuporp es 2OC ed acitÃrcrepus aicnetop ed olcic remirp lE .radn¡Ãtse sal nos sacitÃrcrepusartlu y sacitÃrcrepus satnalp sal ,etnemlautcA .]8[sarutarepmet y senoiserp satla sal ratropos naÃrdop euq selairetam soveun ed ollorrased le euf oÃfased lapicnirp lE .anibrut al ne artne euq ropav led ojabart ed dadilibinopsid royam al a odibed roiretsop aicneicife anu ne etnemlapicnirp ev es acitircrepus lis³Ãf aÃgrene ed satnalp ne oicifeneb lE .acimr©Ãt aicneicife al ratnemua arap acitÃrcrepus n³Ãicarepo al a azalpsed es euq eniknaR ocis¡Ãlc olcic le noc ralimis n³Ãiculove anu obuh euq raton etnaseretni sE .]7,6[rolac ed etneuf al ed odarutpac odneis rolac s¡Ãm y acimr©Ãt aicneicife main option for a refrigerant. Ammonãaco systems were preferred on CO2 systems since they had good efficiency, however, CO2 systems are small and do not pose toxicity risks. In a one Heat pump, the coolant always remains under the critical point and heat rejections are made by condensation. While, in a transcritical cycle, heat rejection occurs at a supercritical pressure from a sensitive cooling of a single phase. The difference in pressure levels in a transcritical CO2 system is much higher compared to a conventional subcritical system. This brings with it additional thermodynamic losses and break. However, the large pressure difference allows the use of an expansion work recovery device that partially offsets losses in a CO2 transcritic heat pump [11]. In what follows the supercritical/transcritic heat pump will be discussed in addition to the supercritical/transcritic ORC as many of the features are shared. A workflow achieves a supercritical state (i.e., it becomes a supercritical fluid) when the pressure and temperature is at or above its critical pressure and temperature. In the steam generator of an ORC, the critical pressure work fluid heats from the subcooled conditions through the critical point that ends in a supercritical state. During this process the temperature of the work fluid increases and during the subcooling phase follows the liquid saturation curve closely. This property is exploited by recovering energy from sensitive heat currents. It is known that the heat profiles that are closely matched (see Figure 1) are beneficial to increase the thermal efficiency (higher average temperature of the workflow) and increase the recovered energy (cooled-flavor heat current at a lower temperature) [6]. For water, both critical temperature (647.096 K) and critical pressure (22.064 MPa) are high while for CO2 critical temperature (304.36 K) is low and critical pressure (7.38 MPa) is low.These high pressures generate technical challenges and additional costs of material [12]. In addition, complex multi-stage pumps are required to achieve al ne otnemua nu ,sodalucniv etnematcerid n¡Ãtse arutarepmet al y n³Ãiserp al ,esaf ed oibmac ed n³Ãiger al ne euq a odibeD .selbisnes rolac ed otneimanecamla y n³Ãiccafelac ed sametsis sol ne solpmeje nartneucne eS .etnatsnoc arutarepmet anu a rolac nereiuqer ermpeis on senoicacilpa sahciD .otneimatnelac ed senoicacilpa arap azilitu es euq odazahcer rolac le noc elbairav arutarepmet a erruco n³Ãicasnednoc al y acimr©Ãtosi n³Ãicaziropav al odatluser omoc ad rolac ed ortsinimus le ,etreivni es ocit-Ãrcsnart olcic ohcid iS .ocitÃrcsnart olcic nu omoc econoc es secev a ocitÃrcrepus olcic le ,elbairav etnemaunitnoc arutarepmet anu a erruco ropav a adiuqÃl n³Ãicisnart ed esaf al euq sartneim ,etnatsnoc arutarepmet a ragul eneit n³Ãicasnednoc al ednod ,aicnetop ed n³Ãicareneg al araP .royam euf otneimidner ed aicnanag al ,sajab s¡Ãm rolac ed etneuf ed sarutarepmet araP .soudiser sol ed rolac led arutarepmet al ed odneidneped socitÃrcbus socro sol noc n³Ãicarapmoc ne royam %01 na tsah are socitÃrcrepus solcic sol ed yel al ed aicneicife adnuges al euq norartnocne]5[.la te etpmoceL .s¡Ãgoib ed)PHC(adanibmoc aicnetop y rolac ed odanibmoc ametsis nu ed epacse led laudiser rolac led n³Ãicarepucer al arap ocitÃrcrepus y ocitÃrcbus CRO nu ed otneimidner le rarapmoc ed ovitejbo le noc aÃgrexe ed sisil¡Ãna nu obac a ³Ãvell]51[.la te ilguaY .lanoicnevnoc CRO nu noc n³Ãicarapmoc ne oilpma s¡Ãm ognar nu ne rarepo ed zapac se y etneicife s¡Ãm ohcum se ocitÃrcrepus olcic nu ,soudiser sol ed rolac led n³Ãicarepucer al omoc senoicacilpa arap euq ed n³Ãisulcnoc al a noragelL .odarg ojab ed rolac ed setneuf odnazilitu ram ed auga led n³Ãicazinilased al a sodacilpa socitÃrcrepus socro ed osu le ³Ãgitsevni]41[.la te iL .socitÃrcrepus CRO sol ed otneimidner ed oicifeneb le etnemacir³Ãet nagitsevni soidutse sohcuM .]31[odicudorp otubr redop led etrap narg anu a ¡Ãrdlaviuqe adazilitu aicnetop us ,sajab nos sabmob sal ed saicneicife sal iS .senoiserp the cycle inevitably increases the overall pressure ratio. Supercritical steam compression cycles are inherently free from this limitation. Supercritical heat pumps for industry application are mainly studied in a theoretical basis in theLi et al. [16] proposed a supercritical heat pump with two evaporators with CO2 as work fluid for drying application. Klocker et al. [17] made a comparison between the benefits of a supercritical CO2 heat pump with a heating system of the ctric eligion and found that the savings in energy of up to 65% can be achieved using an optimized supercrytic heat pump. Diaby et al. [18] used a CO2 heat pump transcrytic cycle to evaluate the performance of two heat pumps at: i) heater yield (COP) between two and three. After the reduction of fluorid fluids in the refrigeration sector in Europe, the inter -site of CO2 has grown. In comparison with other commonly used work fluids, CO2 is a natural work fluid with low PCA (= 1) and without PaO. It is also flammable, not explosive and cheap comparison. It is clear that there is still a gap for work fluids that have low temperature and pressure. Table 1 lists some refrigerants with zero pao that show potential for the supercrytic operation of RDC. However, the majority of organic fluids have low stability of the fluid, high flammability and corrosivity nearby or in supercritical pressure operation [19]. From the previous analysis it is clear that supercrytic and transcrytic cycles offer possibilities to improve the performance of heat systems to power and heat to heat. However, the experimental results are scarce in the literature and for the authors there is no exhaustive review available. Therefore, in what follows, there will be a general vision of experimental research on heat cycles to supercrytic and transcrytic. The generation of From the heat of the waste it is usually economically feasible when the temperature of the heat source is greater than 150 ° C. The main power to power heat systems can be classified as conventional conventional conventional (Rankine-base,) Direct power conversion (turbo-compounding) and advanced technology (teg among others). Among the cycles of mechanical power, the Rankine Steam Cycle (SRC) and the Organic Rankine (ORC) cycle, both following the same configuration, are widely developed; They only differ in the work fluid [20]. There are several more to improve the technical efficiency of a Rankine cycle. One way to increase the efficiency of the cycle is to increase the temperature of the steam that enters the turbine. However, this temperature is restricted by metal limitations imposed by the materials and design of the components and the primary pipe. The equipment and pipes must withstand high pressures and large tensions at high temperatures. With new material development it is possible to go at higher temperatures during overheating and overheating. To balance that with moisture in the last stages of the turbine, the most high boiler pressure is required. The majority of the technical centrals are currently designed to operate in the supercrytic rankine cycle (that is, with steam pressures greater than the chrotic water pressure 22.1 MPA, and turbine input temperatures greater than 374 ° C). Supercrynic energy plants have efficiencies around 43.% In addition, 48% efficiencies are reached for very complex carbon energy plants that operate to pressures â € œ ultra character (that is, about 30 MPa) and use reheating of multiple stages (vé © ase Figure 2) [21]. Although the majority of the supercrytic units are carbon, in 2014, the organization of scientific and industrial research of the Commonwealth (CSIRO) of Australia established a world cord in the generation of steam Solar with a more than 600 directional mirrors (heliostats) aimed at two towers that house ocip le noc itpmocced fo elbatius noitarepo laicremmoc eht gnidliub ... The obtaining of greater general technical efficiency of the CCGT requires optimizing the entire plant and the three main components: the gas turbine (GT), the heat recovery steam generator (HRSG) and the steam turbine (ST). However, among the three components of the CCGT plants, the GT performance enters first as the predominant performance in performance; with which plant efficiency can address the 55% objective and more [23]. Another concept, proposed by Xu et al. [24], investigate a supercrytic supercrytic energy generation system of 1000 MW that incorporates a complementary regenerative supercerative CO2 cycle. The general efficiency of the proposed system reached as high as 46.0%, 0.4%higher than that of the reference energy plant and could rise to 46.9%when the gas temperature of the exhaust pumps fell to 100.0 ° C. As mentioned in the previous section, the Sâusic Syndic Cycle of Rankine (ORC) presents exactly the same configuration as the Supercrytic Rankine Steam Cycle (see Figure 3), however, the work fluid is a fluid is a fluid a thermal instead of water. Organic fluids that can be used in temperatures below 400 ° C do not need to be highly overheated in the majority of cases, a fact that leads to greater efficiency of the cycle [25]. This allows low -degree heat sources that otherwise will be wasted. However, unlike the large -scale utility vapor power plants where the use of supercrytic cycles, in small/medium -sized systems, using a supercrytic orc, the selection of the selection of appropriate components become very challenging. In addition, the low temperature operation (under 100 ° C) brings some additional restrictions, as a limited number of fluids can be used for such purposes and cycle [53]. ... A fluid vasta operating through a transcrytic cycle ... Although the majority of the supercrytic units are carbon ... The work fluid of the ORC cycle is a fluid is a fluid a thermal ... work, although limited, has provided some important results on the efficiency of the cycle and the production of energy under transcritical conditions. Several tests are carried out by Kosmadakis et al. [35] in the laboratory have demonstrated a cycle efficiency of 4.4% in supercritical conditions, when in the subcritical operation it reached a value of 7%. However, the supercritical operation was difficult to achieve and only when the cooling water flow rate decreased, the average temperature of the condenser rising, but maintaining a pressure ratio close to the designed one, but leading to a low expansion efficiency. However, the actual test data and their study provide good arguments if a supercritical cycle is used, which can be really more efficient than a subcritical cycle, and if the theoretical results can be verified. The thermal efficiency results in the CPV system held during the tests were lower than expected, and under supercritical conditions. The most important findings of the laboratory tests were that such an orc engine with a capacity of only 3 kW can achieve adequate thermal efficiency when operated at low heat temperature. In Landelle et al. [37] Tests, the ORC displacement expander was able to produce up to 6 kw gross, with a supercritical R-134A supply and has demonstrated good performance, however, the ORC engine performance was insufficient, with a net thermal efficiency of only 1%. However, it showed a good potential for the residual heat recovery application, as it worked better than "the same orc power scale for almost zero recovery efficiency. Hsieh et al. [38] The experimental results showed that your attempt to use a screw expander in a transcritical orc wassince it turned low -grade heat into approximately 20 kW of power. The experimental results also demonstrated a natural efficiency (gross rich efficiency) of (5.7%) 2.66% (5.38.%) and 2.63% (5.28%) for heat source temperatures of 90 °C, 95 °C and 100 °C respectively. Demierre et al. [39] have demonstrated the viability of the turbomachinery-based thermal pump on a small scale demonstrated and the turbine used achieved a efficiency of 0.75 as well as the compressor. However, the energy losses between the turbine and the compressor reached ~30.% A summary of the above-mentioned experimental prototypes is presented in table 2. The main designs of the ORC supercritical engine, as described in the prototypes mentioned above. Carbon dioxide has interesting properties for waste heat recovery with many beneficial features as shown in table 3 [43,44,45]: very low critical point, non-toxic, non-identifiable, widely available, zero ODP, low PCA by definition, etc. A projection of the files shows large amounts of studies on this topic, so the Rankine CO2 cycles will be discussed separately here. Pilot research on the small-scale transcritical CO2 Rankine cycle has been conducted since 2000. The first attempts were made at Doshisha University, Japan, and conducted extensive experimental studies of a supercritical CO2 Rankine cycle system. And since then, few other systems have been built and tested, mainly for heat recovery applications. Table 4 contains a list of various designs and comments in the following paragraphs. Zhang et al. [43,44,45,46] conducted pilot research on a solar-powered CO2 transcritical cycle. In principle, your system uses a solar collector matrix and direct evaporation, a microturbine, a capacitor, a CO2 feeding pump and is designed to operate in CHP mode. Due to the lack of ... a expansion valve was used instead. Zhang et al. ... the experiment with a CO2 supercritical condenser ... Li et al. [47] proposed a small-scale experimental transcritical CO2 Rankine cycle which they integrated a 2 kW piston expander coupled to a generator, shell and tube heat exchangers that can withstand a pressure of 20 MPa such as evaporator and regenerator and another that can withstand a lower pressure like 8 MPa as a capacitor. A piston pump was used with a nominal pressure of 20 MPa as a power pump. A 34 kW cooling unit that provides 5 °C of cold water was connected to the capacitor. An oil loop with an electric heater produced hot fluid at an approximate temperature of 210 °C. A test facility was built for research on small-scale transcritic CO2 Rankine cycles by Ge et al. [48]. It includes a CHP 80 kW microturbine unit, an oil loop, an integrated Rankine engine and a dry cooling system. The CO2 turbine was an axial, with a single stage and a reaction ratio of 0.5. It was designed for 5 kWe output power, 0.281 kg/s of mass flow and has a diameter of 144 mm. The CO2 feed pump was a triplex pump. The temperature of the hot oil and the flow rate of mass were varied through the CHP power output and the speed of the variable pump, respectively. As its system was designed, four two-way valves were installed to prevent the recover when necessary. Therefore, the system parameters could be measured in both configurations: with and without recoverer. Li et al. [49] decided to build, test and compare a small-scale transcritical CO2 Rankine cycle and a small-scale transcritical Rankine cycle using R245fa. The system investigated by Ge et al. [50] was complemented by an ORC engine. The ORC unit uses copper pipes instead of stainless steel as regards the CO2 test platform. ORC turbine was axial with one stage. The working fluid pump was a diaphragm pump coupled with a 1.1 kW asynchronous engine, and two separate air capacitors mounted and controlled by variable speed fans. As both engines were driven by the same heat source, two valves ## I mean, I don't know. The author showed that the supercrytic carbon dialog had better heat transfer characteristics [44]. The estimated output power was 820 W. The maximum temperature and the pressure of around 187 °C, and 9.26 MPa were reached and the system produces a general efficiency of around 9%, well above that of heat of a solar cup, 8.2% [43]. Pan et al. [47] They used bolts as an elgric load and the investigated system produced around 1 kW of electrical power, and produced an efficiency of 5%. They discovered that the pistoner of the piston worked badly and showed an isentropic efficiency as low as 22%, and concluded that it was not adequate. In addition, they indicated that an increase in mass flow causes the pressure on the evaporator to increase. Ge et al. [48] â € ôth â € «evaluated the experimental performance of a low -grade heat driven CO2 -driven cycle and few results were obtained. The test results showed a correlation between the mass flow rate of the CO2 cycle and the input and output pressures of the turbine and subsequently with the power generated. The output power varied with the workflow of work flow and the rmico dough. The maximum isentropic efficiency of the turbine was 45% and showed low yield when the CO2 mass flow rate increased. Of the experimental results obtained, these authors were able to develop and implement a model in Trnsys to predict the impact of ambient air temperature on the system. Li et al. [49] Probe transcritic and subcritic cycles R245fa R245FA driven â € ‹â € by the same heat source in view of the performance comparison. The entrance paraâ € -0.3 kg/s work fluid flow, oil temperature 139 ° C and 130 ° C for CO2 and R245FA, and ambient air temperature 24 ° C and 17 ° C respectively. The test results in both configurations showed that the pressure in different parts of the system, energy and turbine efficiency increased with the rate of mass flow of work, while cycle temperatures decreased with an increase in mass flow rates and cycle power output increase. The maximum electric efficiency of the CO2 cycle was around 90 bar for the transcritical cycle, that is, more than seven times that of the subcritic, 12 bar. The heat transfer analysis in the evaporators/gas heater showed that the transcritic cycle has the potential to function better than the subcritic configuration. Positive variation of heat input, affects both temperature and cycle pressure. The isotropic efficiency measures of the expansors were less than 40%. However, the authors failed to achieve significant results, such as the output power of the cycle and the efficiency of the system of both systems in similar conditions for a significant comparison. Shi et al. [50] aimed at improving the transcritic operation by modification of the cycle architecture and comparing four configurations: basic cycle (b), regeneration cycle (R), preheater cycle (P) and cycle with regenerator and preheater (PR). They were able to demonstrate that integrating a regenerator and preheater is the best option, as it provided the best performance: 34 kW power output, 7.8% thermal efficiency and 17.1% exergy efficiency. It should be noted that of all configurations, the core cycle showed lower performance. However, the results were not realistic as the system did not produce any work, and the yields were overestimated. Li et al. [51] proposed evaluating the dynamic behavior of a transcritical system by massive flow and variation of the expansion relationship. The variation of the fluid mass flow rate was obtained by the variation of the pump speed. Experimental results showed that the pressure relationship could be achieved by opening the expansion valve. The decrease in mass flow induced an increase in pressure at the entrance of the valves and an increase in temperature. A decrease in the opening of the valve tended to an increase in pressure and at the valveA¢ÂÂs inlet, a decrease in mass flow was also observed despite fixed pump rpm. Overall, the system showed good dynamic response with average time response below 62 s. Heat transfer optimization is an important issue in CO2 transcritical cycles. Shi et al. [52] in their research tackled the issue by integrating a preheater in their system. They kept different pumps at fixed speeds and varied the pressure in the gas heater, in the range 7.57¢ÂÂ10.35 MPa and obtained a gas heater efficiency of 73¢ÂÂ80% and a preheater efficiency of about 80%. They suggested further work to improve the gas heater, and proposed engine coolant pump frequency selection as way of optimizing preheater¢ÂÂs operation. A Brayton cycle can be implemented with working fluids such as carbon dioxide (CO2), air, helium (He), ethane (C2H4), sulphur hexafluoride (SF6), xenon (Xe), methane (CH4) and nitrogen (N2). The standard configuration can be modified to give birth to other layouts with the aim of increasing the cycle efficiency. More than a dozen layouts have been investigated so far throughout the literature [54,55,56,57,58,59]: standard Brayton, pre-compression, recompression, split expansion, partial cooling, cascade, simple reheat, double reheat, etc. These architectures are meant to be applied for power generation from various heat sources including coal combustion, thermonuclear reaction, solar radiation harvesting and waste heat recovery [49,60]. Mecheri and Le Moullec [61] investigated the possibility of applying Brayton cycles for heat recovery in coal power plants. Several possibilities with supercritical carbon dioxide were screened of which the recompression cycle emerged as the best option with an efficiency increase of about 4.5%pt in comparison with the standard Brayton cycle. Concentrating solar power developers are also seeking for competitive designs, and efficiency increase through Brayton cycle have been proposed. et al. [62] investigated the Brayton cycle for solar power plants ... Ma and Turchi [63] argue that replacing the Rankine steam by SCO2 Brayton on the tower plants has many benefits: compatibility, modularity and efficiency. Stein and Buck [64] compared several options for solar energy, and Brayton appeared as a promising option, but it has not yet been confirmed by demonstration plants. Brayton cycle is currently being investigated in the nuclear industry for use in fourth-generation nuclear power reactors [64,65,66,67]. Sodium-cooled fast reactor, lead-cooled fast reactor, gas- Cooled fast reactor, super-critical water-cooled reactor, gas-cooled reactor at very high temperature and salt reactor. It could be well adapted for temperature in the range of 500 ° C to 900 ° C, with an efficiency of about 50%. Brayton cycle performance is affected by several factors, including turbine input temperature and pressure ratio. Performance can also vary depending on the cycle architecture, and the repressive cycle was proposed as an appropriate option for the maximum cycle temperature of around 500 ° C, pre-compression and partial cooling are the right options for processes over 500 ° C Since the 1960s, several testing facilities have been built in the world, with an output power ranging from KW to the tocomo target scale of the transfer of MW. However, since the 2000s, there has been a steady increase in experimental research with respect to ... ## Stanford Brayton, ... Tokyo Institute of Technology ... the first experimental tests were carried out ... SCO2 turbine ... The system was applied to ... Sandia National Laboratories ... A test loop for S-CO2 ... eval/ a et al. the system was ... Knolls Atomic Power Laboratory ... Utamura et al. [77] ... the first experimental demonstration ... They used a recuperated Brayton cycle ... the loop was designed to ... steam at 250 ° C ... The Tokyo Institute of Technology ... carried out of tests ... 2 RPM ... Rosseevr ... [68,70] ... Brayton cycle ... Vojacek et al. [68] In CVR, Czech Republic built a small -scale test installation within the framework of the Susen project. The installation is intended to be used for component tests at temperature up to 550 ° C and pressure up to 30 MPa. The test platform built in CVR, aimed at trying heat and turbomachinery exchangers. The compressor worked as expected while the closed loop operation of the simple Brayton cycle was not possible due to the excess pressure. The 1 MW recovered cycle built in Swri [72] saw its first tests, and the turbine reached a temperature of 550 ° C to 21 krpm. Future experimental investigations are planned and will focus on taking the temperature to the point of design set at 715 ° C/25 MPa. Anselmi et al. [77] reported on the development of a test platform at the University of Cranfield (United Kingdom) if they had the intention of testing several components integrated into a CO2 loop. In South Korea, Kaeri, Kaist and Postech have joined to carry out research on Brayton supercrytic cycles. They have developed an integral test installation S-CO2 (Sciel) with the objective of operating test cycle and components. Two projects were launched for a high and low compensation relationship [54,78]. The first test platform was a Brayton recovered with two -stage compression and two -stage expansion. The turbines were designed for a low pressure relationship, (2) and could support a temperature as high as 500 ° C, well adapted for an SFR. The second was a simple Brayton cycle. In the Kaer, a research plan was established to investigate the Rankine and Brayton transcritic cycles. Several cycle architectures with different power outputs should be tested and evaluated [79.] Selected architectures Brayton were closed is Brayton and Dual Brayton. In the course of your designed experiment and built a small high -speed turbo generator (1 kWe, 200 KRPM) for a multipro -troprop test loop that could work at high speed at high speed speed (500 ° C) as simple and low temperature Brayton (200 ° C) as a transcritic cycle of Rankine [80]. The first system designed by Echogen was a 10 MW SCO2 plant based on an innovative recovered cycle. The tests were carried out in its installation of EPS100, which integrates the printed circuit heat exchangers (PCHE) as a recovery and refrigerator, fine tube designer heater, a turboquette that consists of a hermetically sealed unit and An elgric turbine coupled to an elgric turbine of four poles with four poles. Generator [73]. The initial tests took place without the power turbine, and the performance outside the component design is measured and the data registered in comparison with the model's predictions were shown in good agreement. In the Kaeri, a simple Brayton was proven [79,80]. The test platform comprises an oil loop, a double pressure motor unit, a power turbine (200 kW output power) and a pre -holder. The turbine was designed to support a pressure of up to 12.5 MPa, a temperature of around 435 ° C and has an 80 KRPM axis speed. Compressor performance maps were drawn, transitory analysis and cycle operation were performed. After registering the cycle parameters, they were able to draw the thermodynamic cycle in a TS diagram and managed to produce 1.2 kW output power. Heat pumps for heat recovery applications have power input and supply temperatures up to 150 ° C for Más [81]. The majority of the commercial and experimental units are based on subcranatic cycles, with few examples available in the literature that operates in transcrytic conditions. A typical cycle design of a transcrytic heat pump that uses an internal heat exchanger to increase cycle performance and table corresponding pressure diameter is shown in Figure 4. Most of the relevant applications refer to a CO2 heat pump as its working fluid, with few more using the alternatives. These are presented below. Heat pumps that work in a transcritical cycle with a CO2 work that attracting much attention especially in the domestic sector. The main reason is the high temperature slip of these type of heat pumps and their high volumetric heating capacity, making them suitable for hot water heating applications. This large lift is possible even with a single-stage cycle, reducing the system complexity and cost. However, they need low temperature in the evaporation side, so as to keep the boiling process within the two-phase region (practically lower than about 25¢ÂÂÂ30 Â°C), which is usually supplied by ambient air. This restricts their use in the industrial sector for heat source is from low-temperature wastewaters or from the rejected heat of refrigeration units [81].In general, heat production of CO2 transcritical heat pumps is limited to a temperature below 100 °C, being suitable for a limited number of industrial processes, such as for drying applications [16,17,82]. Their performance is greatly increased when the CO2 temperature at the gas coolers is reduced as much as possible [83], exploiting most of the thermal content of the high-pressure gas. Heat production at different temperatures in the gas coolers is also possible. At the same time, it is ensured that the working fluid after the expansion process is within the two-phase region.The experimental studies of this type of heat pumps for the production of process heat are limited. Although there are numerous experimental test-rigs for hot water heating mostly for buildings [84,85,86], its industrial application has not been examined so extensively [87]. This has mostly to do with the heat recovery process, where the inlet temperature of the heat source is increasing at temperatures as the ones available in most waste heat recovery applications, as previously explained. Moreover, the maximum heat sink temperatures usually restricted below 100¢ÂÂ120 Â°C, limiting the possible applications [88] mostly for air preheating or for drying purposes [16]. It should mentioned that heat pumps based on subcritic cycles and with other refrigerants, both HFC and HFO, can reach more high heat temperatures from the process well above 100 ° C, reaching 150 ° C, expanding its possible integration into industrial units [81,89,90]. The CO2 heat pump for heat recovery can be an air source, using the technical air of the exit air of the drying or heat processes rejected from the refrigeration units (possibly within the same unit for the same unit for simultaneous production of heating and cooling). Those of water/brine are scarce due to the need to maintain the evaporation temperature below the criticism. The ground source systems have also been examined [91], which show good potential for heating and cooling applications, once they recover the heat of the soil [92]. To reach a temperature elevator of approximately 80 â,¬‹ 100 ° C, a single -stage configuration is adequate, to keep the complexity of the system low, which is one of the main advantages of transcritic heat pumps of CO2 . An internal heat exchanger can also be used, as shown in Figure 4, to exploit the heat content of the pressurized gas, with more small performance improvements as in the cycles of the subcrytic heat pump. In addition, the big pressure difference that even reaches 80 bars of 100 bar makes the compression process very demanding in terms of technology and compressor performance. Relevant to this characteristic of this type of heat pumps, different technology are developed and tested in the laboratory scale units, mainly applicable for heat pumps in the national sector, with the aim of increasing flexibility and COP [93] . However, these can even be applied Big heat pumps for heat recovery, with heat supply of different sources in the air. These two configurations that lead to design variants are briefly present below, without restricting the use of additional variations (being), such as the use of internal heat exchanger, cascade cycles or economizers economizers The big pressure difference makes it appropriate to use expansion devices to recover some energy from the second part of the ... turbines, ... this concept ... to the ... of the cycle [95,96], due to the operation of two phases and other losses (e.g. mechanical,) the potential for job recovery is significant. baek et al. [97] reached an even lower isentropic efficiency of 11% using a reciprocal piston expander, probably due to internal leaks, resulting in an increase of 10 % li et al. [98] ou ut expansor de piston rodante, achieves an isentropic efficiency of 58% and a cop increases in more than 10,% without having any effect on the cooling capacity. Similar findings have also been achieved by tian et al. [99] was experimentally observed even a greater improvement with larger expansion machines based on types of blades by Kohsokabe et al. [100]. the second design to improve the performance of the cycle that is developing is to have an ejector to increase the pressure of the overheated co2. This design is often called thermo compression cycle and performance improvement depends to a large extent on the ejector characteristics [102]. Efficiency of the ejector is usually limited to less than 30 % [103,104], which leads to a cop improvement of up to 10% [105], or even higher in variable operating conditions [106] and the use of multiple ejectors [107] minetto et al. have ... COP can be about 10% higher as in a CO2 transcritical heat pump ... On the other hand, Dayma et al. [114] simulated a transcritical heat pump using N2O, which has similar properties as CO2. The resulting COP is about 5% higher as with CO2, showing however lower volumetric heating capacity and thus requires larger component for delivering the same useful heating.Except from the two above theoretical works, Wang et al. [115] tested in the laboratory under controlled conditions a heat pump using R125, operating at either subcritical conditions or near the critical point. Its main advantage over CO2 heat pump is the lower working pressures and the potential that some more study intended for cooling or heating applications supplied with ambient air. However, this is a small sample of the features of this technology, mostly fitting other applications than heat recovery. Energy demands are ever growing, and methods of the past no longer prove viable. Power production through the use of coal has been prevalent and was reported to produce 41% of all the electricity produced globally in 2013 [116]. The International Energy AgencyÂ¢ÂÂs (IEA) Â¢ÂÂWorld Energy Outlook 2015Â¢ÂÂ reports that the source of highest percentage of CO2 emission are coal power stations.With the European Union determined in phasing out coal to reduce its carbon footprint, new technologies harnessing cleaner sources of energies like solar, wind and geothermal are emerging in response. Meanwhile, attempts are being made to improve existing technologies and finding new ways to produce power that satisfies the demand. Supercritical power plants are an example of such technological improvements.The first commercial supercritical unit in operation was the steam generator from the American Electric PowerÂ¢ÂÂs (AEP) Philo Plant Unit 6, installed in 1957. It could deliver 120 MW of power at 85 kg/s and 31 MPa and was supplied by The Babcock and Wilcox Co. Philadelphia Electric Co. developed a dual reheat steam generator that could deliver 325 MW at 252 kg/s and 34.5 MPa. This equipment was manufactured using stainless steel materials and helped pave the way for supercritical boilers. It is evident by now that supercritical (SC) and ultra-supercritical (USC) power plant technologies are very efficient technologies of power generation [117].There are some supercritical ORCs in commercial use as well, some of which have been enumerated in Table 5. Even though highly efficient in theory, it is difficult to demonstrate the operation and exercise control over CO2 supercritical power plants. Hence, supercritical pilot power plants with long operational background that can display cycle feasibility are scarce. Data available to the research community are produced by very few labs as discussed in Section 2.3 and Section 2.4.With an interest in CO2 as a working fluid, a number of heat pump systems have been in use in commercial operation and research studies. Mayekawa [118] and Mitsubishi Electric [119], for example, produce commercial heat pump systems that operate on waste water sources and provide hot and cold water.The use of water as a working fluid in supercritical power plants is the largest application of any fluid at supercritical pressures in an industry. However, there are a number of areas where other supercritical fluids are used currently, or can show performance benefits in the near future [120,121,122] as given below:Supercritical carbon dioxide as a refrigerant in air conditioning, refrigerating systems and power systems.Supercritical refrigerants in thermodynamic cycles for heat and power conversion.Supercritical carbon dioxide, near-critical helium and liquid hydrocarbon used as cooling media.However, at the moment there is no general adoption of supercritical fluids in thermodynamic cycles. is primarily due to the unknown behavior of the supercritical fluid in the heat exchangers at design and during operation. It is known that in the supercritical region the thermophysical properties change drastically with temperature and pressure. The near-critical point is actually a region around the critical point where all thermophysical properties of a pure fluid exhibit rapid variations. In contrast to the refrigerants used in ORCs or heat pumps, supercritical heat transfer has only been investigated in some detail already for CO2 and water [123,124]. An example of data found for water is given in Figure 6. These unknowns now pose a high risk for potential manufacturers which are typically small to medium sized companies.In addition, there are regions of heat transfer enhancement (HTE) and heat transfer deterioration (HTD) [125]. However, even for CO2 and water, there is no consensus on the physical explanation. Yet, it is clear that these effects lead to flow instabilities during operation and they complicate the design of heat exchangers. For ORCs this becomes even more of an issue as the heat source frequently shows intermittent behavior as waste heat availability and solar irradiation changes. As such, understanding the flow behavior during heat transfer to supercritical refrigerants is a crucial step to design supercritical ORCs and to avoid unstable operation. Unfortunately, this specific research is mostly lacking in scientific literature.Another technology that influences the economy, safety and reliability of a high-pressure plant and sits at its core are the high-pressure pumps and compressors [126]. The challenge in designing pumps operating at high pressure include proper sealing, fatigue, wear, installation and vibration which come up in such applications. In these conditions, high stresses and strains are generated in the liquid containing parts leading to fatigue and hence, non-conventional and design and manufacturing techniques are required. From the point of view of the increase in the efficiency of the energy plant by increasing the pressure and temperature of the steam input, there is a reduction in the energy demand of almost all auxiliary equipment, except the feeding pump of the boiler. The reason detriment of this is the linear dependence on the power necessary to conduct the pressure pump to the pressure. This results in a substantial increase in the power pumping power of feeding water, although there is an increase in pump efficiency [126]. When compressors are used to work in a transcrytic or supercrytic cycle of the heat pump, due to the leakage of extremely high pressure differences, it becomes an important problem and affects the performance of the compressor. Although much is known about the design and the technology of the turbine, there is limited information and there is limited information and operational experience of supercrytic CO2 power turbines. Operating with CO2 at a critical point with rosely variable properties is a relatively new and unexplored ride for turbomacin design. The design challenges faced here are somewhat similar with those found during the pump design, for example, reliability and coatings of materials, stamps, bearings, corrosion, erosion and cooling of blades, especially in applications with a high turbine input temperature. The challenges on material reliability include carburization and sensitization, high temperature corrosion, erosion, creep and tismal fatigue. Although the temperatures below the temperatures of 500 ° C CO2 are inert, the studies have suggested the corrosion and the carburement of the steel and nickle alloys in the presence of CO2 at high temperatures, especially when the water present even in a small amount, or any other contaminant for the case. [127,128,129]. Degradation mechanisms and long-term behaviour of corrosion and carbiization should be further investigated. Concerns about climate change, future oil depletion and growing demand for energy arecimanydomreht lacitircrepus fo etar noitpoda eht esaercni ot wolla dluoc siht fo stluser ehT .)regnahcxe taeh ,rosserpmoc ,rednapxe ,pmup ,.g.e(noitarepo lacitircrepus rof dezimitpo era stnenopmoc niam eht fo lla erehw dedeen si ngised detargetni na erutuf eht nI .siht etartsnomed ot gnissim era sgir-tset latnemirepxe gnimrofrep hgih tnemom eht ta tub yceniciffe ygrene esaercni ot laitnetop eht evah selcyc cimanydomreht lacitircrepuS.spmup taeh dna sCRO ni desu stnaregirfer eht rof yllaiceps ,sdiulf lacitircrepus fo roivaheb refsnart taeh ni gnikcal si hcraeser eromrehtruF .secnamrofrep detcepxe morf raf llits era ew wohs stnemirepxe tub yceneicffe rehgih sti rof dehcraeser ylesnetni era selcyc notyarB lacitircrepuS .yrenihcamobrut dezimitpo-non ot eud ylniam secnamrofrep roop yalpsid stluser elbaliava dna ecracs era erutaretil ni stnemirepxe .stnaiftemmos rof sseldeen yaw ni selcyc lacitircsnart erutarepmet-wol rof yllacificepS.stnirtsnoc)tsoc ,yefats ,Lumnnorivne ,.e.i(Rehto Era Ereht Ro erararepmet dna eruss erp hgih ta elbats ton si diulf gnikrow eht ro noitacilppa eht hctam tÃÂÂ¢nseod erutarepmet lacitirc eht rehtiE .noitarepo lacitircrepus rof elbatius deredisnoc era sdiulf gnikrow wef yrev ,ylduocS.ngised gnireenigne wen rof sllac ti os dedeen llits si hcraeser fo tol a ,diulf gnisimorp a sa sraepa 2OC hguohtlA .2OC htiw gnikrow selcyc notyarB dna spmup taeh lacitircrepus osla dnetxe ressel a ot dna)tnalp rewop maets lacissalc ,.g.e(selcyc eniknaR lacitircrepus edulcni eseht .snoitaulis cificeps ni detpecca llew ydaerla si noitarepo lacitircrepus ,lla fo tsriF.yduts eht morf nward eb nac snoisulcnoc lareveS .yrevocer taeh rof noitacilppa rieht no gnisucof ,stniopweiv laicremmoc dna latnemirepxe morf deweiver neeb evah spmup taeh dna notyarB ,eniknaR gnidulcni smetsys elcyc cimanydomreht lacitircrepuS .smetsys rewop dna taeh noitareneg txen rof detagitsevni Gnieb suht era egnar siht ni gnikrow selcyc dna ,detceles era sdiulf elbatius ... and increase energy efficiency. Examination of supercrytic CO2 power cycles, B.T.; Heat writing to update heat section "Review, G.K.; INTRODUCTION PROJECT AND SECTION 4â € Draft Section of Introduction, A.P.; Rankine steam cycles, supercrytic Orc, E.N.; Contribution to the intermediate and final exam, D.M. The work of G.K. Relevant to heat pumps has been carried out within the framework of the Industrial Scholarship Program of the National Center for Scientific Research â € œdemokritosâ €, co -financed by the Stavros Niarchos Foundation. S.L. It is a postdoctoral combination of the Research-Flanders Foundation (FWO, 12T6818N). A.P. He has received financing from the Horizon 2020 Horizon and Innovation Program of the European Union through the subsidy agreement No. 764042 (European Union Project). The authors declare that there is no conflict of interest. Papapetrou, M.; Kosmadakis, G.; Cipollina, A.; La Commare, U.; Micale, G. 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A new refiguration of the power of organic cycle of Rankine Rankine Cimanyd No Stset Yaranimilerp ,uil ;.t ,Nehc ; â951 ,051 ,7102 .ganam .srevnoc yrene .yrevocer taeh Eigne rof smetsys)Critc(elcyc enictar lacitircsnart desab 2oc Ruofe Nosirapmoc ,d ,g ; ;. ,nait ;g ,uhs ,l ,ihs]ferssorc[ ]ralohcs elgoog[.717â"â€â807 ,631 ,8102 .gne .mreht .lppa .snoitot-whol edarg-whol CINAGRO AF542r DNA Selcyc Rewop Lacitirop Lacitirpsnart 2OC Neewteb Nosirapmoc dna sisylana latnemirepxe .a.s ,72 ,oul ,oul ,eg ,eg ,w]Fersssorc[, Ygrene .LPPA .Selcyc Rew Lacitircsnart 2OC htiw Mesys Noitareneg Rew-Wol A FO Noitalave Ecnamrofrep ,uossat ; ã¢742 ,59 ,6102 yrene .elcyc rewop lacitirpsnort 2COC eht nootagsevxe ,il ,il ;.x ,iew ; .745â€â€â045 ,84 ,84 ,5002 B .res .tni Emsj .YGRENE ralos yb REUP ELCYC ENIKNAR DESAS 2OC FO YTUISIFISAF A .N ,MOTOMONE ; ,.r-.x ,GNAHZ]Ferssorc[ ]ralohcs elgoog[.8711â"â€â8611 ,53 ,0102 .Ser ybrene .j .metni 2octcrepus scitrcreus scitrcreus scitrcreus scitrcreus scitrcreus scitrcreus sciter H ,ihcugamay ; .R.X ,gnahz]Ferssorc[ ]ralohcs elgoog[.8262â"â€â7162 ,23 ,7002 yren .were .2oc lacitircrepus gnnesy ,h R.X ,gnahz.)9102 yraurbef 5 No Desmecca (Erutaretil/Nro.Crockwww :Enilno Elbaliava ;1102 Rebmetpmes 32â"Strehten Eht ,tnord Ts1 CRO EHT FO sgnideecorp of the of a CO2 transcritical power cycle using an expansion valve in engine waste heat recovery. 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Variations of the thermophysical properties selected from the water near the pseudocritic point: the pseudocritic region to 25 MPa is approximately ± 25 ° C around the pseudocritical point. Figure 6. Variations of thermophosic properties selected from the water near the pseudo-critic point: the pseudo-critic region to 25 MPa is approximately ± 25 ° C around the pseudo-critical point. Table 1. Workflows suitable for supercritical operation. Table 1. Workflows suitable for supercritical operation. Fluidsmol. WT.NBP (â ° C) PC (BAR) TC (â ° C) GWPR744444.01â€œ56,673,831.11r17030.07â ¦88,648.732.23r744a44.01â rate'88.572.436.4298r4134.03 109. R3252.02â' 51.657.878.1550ب127042.08â 47.746.692.42' ج29044.09â 12.142.596.73'ﻝ152a66.05 24.054.20113.3120 ﻝ3h440.06 ' 12â 11.836.30134.63ﺏ Table 2. Experimental prototypes in small and large-scale systems. Table 2. Experimental prototypes in small and large-scale systems. Small-scale system application range [° C] Energy production [KWEL] RefrigerantCPV-T Orc with displacement expansion and development of heat exchangers, Kosmadakis et al. [35] 65 €-1003R-404 ORC ORC ORC with ESCANCIAN EXPANDER AND CUATRO heat exchangers, Landelle et al. [37] 55 €-1201.5R-134 Orcitical Orco with two multi-stage centrifugal pumps and a double screw expander with induction generator, Hsieh et al. [38] 90 €-10020R-218 Orc Gupercritical with oilless compressor turbine unit for a heat-driven heat pump, Demierre et al. [39] 95 €-1232R-134 ALARGE Systemsssupercritical Orc for geothermal applications, variable operation according to available heat, Astolfi et al. [41] 120 € "180500R-134 superpercrytic orcos with induction radial output turbine and workflow PP1, Spadacini et al. [42] 130 € "1701000pp1supercritical Orco with two-stage turbocompressor for the recovery of heat from theof a gas turbine in a natural gas pipe, Copco Atlas and district power. [13] 2507500 BUTANE TABLE 3. Physical properties of the Carbon dioxide. Table 3. Physical properties of supercrytic carbon dial. M (g/mol) BP (° C) CP (° ° C/MPa) AshraeodPGWP100 Yearathm. Life (Year) LFL%44â^'78.431/7.38a101 Confined 50 None Table 4. A list of experimental studies and main design. Table 4. A list of experimental studies and main design. Authorheat Transference/Gas Heaterturbine/Expansion Devicefluidsfluid Pumpcooling Systemaplication Li et al. [49] Lychid gas of a unit of 80 kWe chp / oil Type heat rmicocamcamocamcamient refrigerated et al. [48] Lychid gas of a unit of 80 kWe CHP / Rmico Type (124-144 ° C) 5 KWECO2triplex Plungal Heat Exchanger Refrigerated air Recriguer Recovery Heat Pan et al. [47] Oil Heater/Themal Oil/Shell and Tube Hx2 Kw Rolling Piston Expanderco2Planger Pump (2/20 MPa) Threshold and HX tube/Frão water/refrigeration unit Heat refrigeration Shi et al. 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