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OZONEREPLENISHMENTWITHGASTURBINEOPERATION

K.V.Raghavan, S. Aravind, Sathishkumar Assistant Professor, Department **of Mechanical Engineering,**
Assistant Professor, Department of Aeronautical Engineering ,Dhanalakshmi Srinivasan College of Engineering and Technology, Mamallapuram

ABSTRACT:

The current problem of the day is pollution, especially ozone layer depletion.The depletion is acceleratedby aircraftpropulsionwhichreleasestheimpuritiesdirectly in theaffectzone.Thedepletion accountsforthedamage of all celled organisms. But, at the same time aviation cannot be ruled out as a mode of transportation for istime saving character in this fast blue ball. The project is aimed at making the aviation safer for the planet ie., toreduce the amount of pollutants released by the aviation thrusters and also to accelerate the ozone production. Theproject will gain importance as it reduces pollution and replenishes ozone as these will be the major concern fortomorrow. The ozone is a combination of three oxygen atom. The depletion is caused by the reaction of a member ofthehalogen familywithozoneandalsobythe NO_xreleased fromtheaircraft'sthrustproducers.

We are going to split the water into its molecular components, hydrogen and nascent oxygen. The hydrogenthus produced is let into the combustion chamber and allowed to combust along with the hydrocarbon fuel and thenascent oxygen is released to react free in the atmosphere. The water is split by electrolysis. The combustion ofhydrogen in the combustion chamber reduces the flame temperature. On temperatures above 1500^{o}C, the productionof NO_x starts, the addition of hydrogen reduces these temperature peaks and thus reduces the formation of NO_x.Direct water addition instead of hydrogen to the combustion chamber, reduces the efficiency of the chamber. Thenascent oxygen left out reacts with the halogen family or with the other agents which breaks up the ozone andreduces the possibility of depletion. At better cases, the nascent oxygen may well react with the oxygen molecule toformozonewithsunlightascatalyst.

Keywords:Ozonereplenishment;pollutionreductioninengines;Gasturbineengines;Aircraftpollutionreduction.

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INTRODUCTION:

Ozone is a compoundof oxygenthatcontains three atoms instead of the two found intheoxygengasthatsustainslife.Itwasdiscoveredin1839byaSwisschemist,ChristianFriedrichSchonbein.Inhighconcentration ozone is a bluish green gas, withverystrongoxidizingproperties.Itisatoxic,irritatinggas,oftenencounteredinsurfaceairpollution episodes, when it can trigger asthmaand irritate mucous membranes.Dry air consistsof 78% nitrogen and 21% oxygen and there arenormallytraceamountsofothergases,principallyargon,waterandcarbondioxide,present.The concentration of ozone is usuallyonlyafewpartspermillionandevenintheozonelayeritisonlyone partin100,000. Ozoneiscreatedintheupperstratospherebythephoto-dissociationofanoxygen molecule, which liberates a free oxygenatomandthiscanthencombinewithanotheroxygenmoleculetocreateozone.Thedissociationoftheoxygenmoleculerequiresultraviolet light of wavelength shorter than 240nm.Ozone itself can be dissociated by light ofwavelengthshorterthan1100nm.Thefreeoxygen atom thus created quickly finds anotheroxygen molecule and the ozone is reformed withthe net result of absorbing the solar radiation andinputtingtheenergyintotheatmosphereasthermal energy.The process is very efficient andvirtually all radiation between 200 and 310 nm isabsorbed,despitetherelativelylowconcentrationofozone.Themainozone

absorptionbandsintheultravioletaretheHartley(around200–300nm)andHuggins(around 300 – 350 nm), and there is the weakChappuis band in the visible (440 – 740 nm).Inthelowerstratosphere,belowabout30km,ozone has a long lifetime, and the ozone mixingratiocanbeusedtotraceatmosphericmotions.

Inthenormalstateofaffairsthecreationanddissociationprocessesruninbalance and a typical value for the total amountof ozone in a vertical column of our atmosphereis around 300 Dobson Units (DU), or 300 milli-atmosphere-centimetres, which corresponds to alayerofozone3mmthickattheEarth'ssurface.This 3 mm is in reality spread throughthe column, with the bulk of it lying between thetropopause, at 10 to 12 km altitude, and 40 km,with a maximum at around 17 to 25 km altitudedependingonlocation.Thisistheozonelayer.

Overthelast50yearswehaveintroducedchemicalsintotheatmospherethatarecapableofdestroyingozonethroughphotochemical processes.Chloro-fluoro-carbons(CFCs)arewidelyknown,buttherearealsoother ozone depleting substances such as halons(bromo-fluoro-carbons) and methyl

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bromide.Incertaincircumstancesthechlorineorbrominefrom these substances can react with ozone toturn it back into oxygen.In most parts of theworld the reactions are very slow and there islittledamagetotheozonelayer,howeveroverthe Antarctic a dramatic hole opens in the ozonelayereveryspringandfillsinagainbymid-summer.ThisiscreatedbytheunusualatmosphericconditionsthatexistduringtheAntarcticwinter.

Aninternationaltreaty,theMontrealProtocol,hasbeendrawnuptocontrolthereleaseofozonedepletingchemicalsintotheatmosphere.This treaty is clearly working, andthe amount of these chemicals in airnear thesurface is beginning to decline.The chemicalsare however so stable that it will take a long timebeforetheydrop tothe levelsthatexisted 50years agoandit is likely thatwewill see anannualozoneholeoverAntarcticaformanydecadestocome.

Aircraftsandozonedepletion

Aircrafts which we are operating is oneamongstthemajorcausesforozonelayerdepletionandglobalwarming.Theexhaustgeneratedbytheaircraftscontainspollutantswhich breaks up the ozone molecules and causesdepletion.Theexhaustissuchtoxicduetoincompletecombustionofthefuelinthecombustion chamber and also due to the hightemperatures.

METHODOLOGY:

Wearegoingtosplittheprojectintotwohalves,oneregardswith ozoneformationand theotherwiththepollutionreduction.

At first the water has to be splitted intoits molecular components and then the diversionstarts.Weuseahydroseparatorfortheseparationprocessandtheninjectnascentoxygenintotheatmosphereandthehydrogeninto the combustor.

WATERSEPERATION

Water is a combination of hydrogen andoxygen. There aremanyways of splitting thewater molecule into its molecular constituents.Manytechnologieshavebeenexploredbutitshouldbenotedthatasof2007"Thermal,thermochemical,biochemicalandphotochemical processes have so far not foundindustrial applications."Only high temperatureelectrolysisofalkalinesolutionsfindssomeapplications.

The various other methods of separationareasfollows,

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- Electrolysis
- Thermolysis
- Photocatalyticwatersplitting
- Sulfur-iodinecycle
- Biohydrogenroutes
- Fermentativehydrogenproduction
- Enzymatichydrogengeneration
- Biocatalysedelectrolysis

4.1Methodof choice

Based on the ease of the process, timetaken to generate the product and energy inputrequiredtheprocessesarecompared.TheElectrolysisprocesswhichrequiresjustaminimu mof1.5Vfortheseparationisselected.

The separator configuration is180 Litres/Hour

InputVoltage(V)	:AC220
WorkingMedium	:WaterOperationGasPressure (KPa):1.5Rated
OutputGas(L/h)	200
Weight(kg)	75

TheHydroseparatorisshown inFig4.1

COMUUSTOR:

combustionchambersandtypes

Therearethreetypesofcombustionchambersusedforcommercialaircraftpropulsion.Theyare

- ✓ Cantype (Fig5.1)
- ✓ Annulartype(Fig5.2)
- ✓ Canannulartype (Fig5.3)

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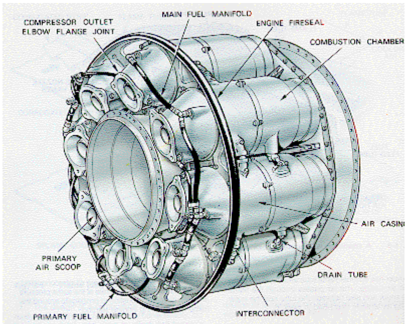

Fig5.1 Cantypecombustor

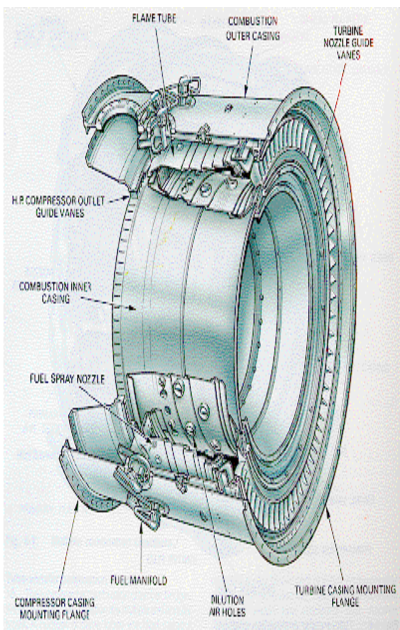

Fig4.1:Hydro Separator

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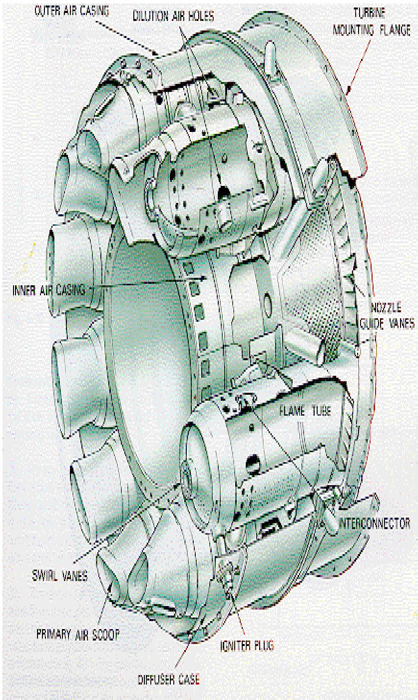

Fig5.3Canannulartypecombustor

Chamberofchoice

RESULTS:

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ForourprocessCantypeissuitable.Why because, a single chamber can be used totest the result and can be integrated to get theresult for the entire engine thus the amount ofhydrogenrequired,fuelandairrequiredareminimum.

DESCRIPTION

Thefabricatedcombustionchambersetup is shown in Fig 6.1, the setup has a hydroseparator, a fuel tank and the combustor setupwithlinesfor compressed air entry.

Fig6.1:CombustorSetup

Pollutionreduction

The testa were carried out in such a waythat at first the cmbustor was operated with inlyKerosine as its fuel and the exhaust is studied.Then gradually Hydrogen was taken up to thecombustorandtheexhaustwasstudied.Theproportionsofthehydrogeninjectionwasincreased and the same studies were carried out.Theobservationisthat,withtheinjectionofHydrogenthepollutantlevelintheexhaustreducessignificantly.

ThemagnitudechangeisshowninTable1.

TEST RUN	KEROSINE (MLPS)	HYDROGEN (MLPS)	Co (%)	HC (ppm)	NO_X (ppm)
1	16.67	0	9.87	9200	162
2	15.83	0.83	9.12	8071	156
3	15.00	1.67	8.65	6793	134
4	14.42	2.5	8.35	4643	110
OVERALL DECREASE			1.52	4557	52

Table1:ExhaustCharacteristics

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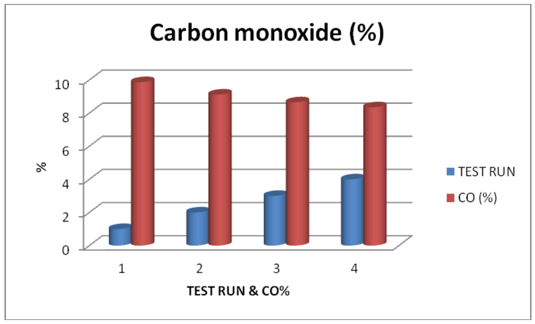

Fig7.1Carbonmonoxidereduction

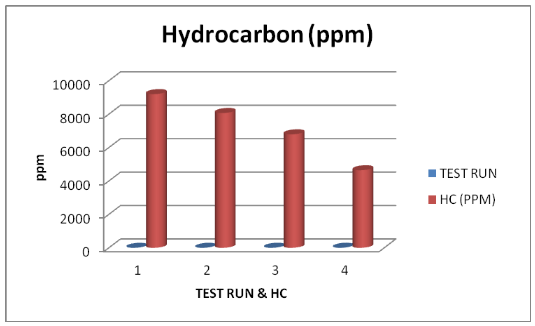

Fig7.2Hydrocarbonreduction

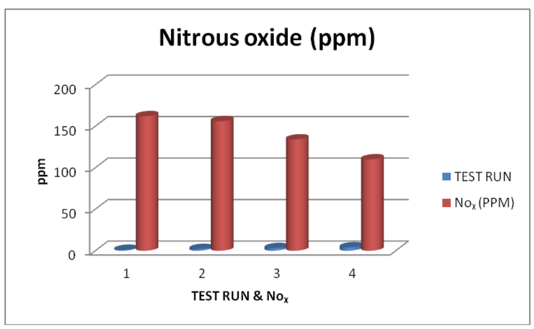

Fig731Nitrousoxide reduction

AsshownbythecomparisonchartsthattheamountofpollutantlevelintheexhaustdecreasessignificantlywiththeinjectionofHydrogen into the combustor. A positive rsult asexpected.

Ozoneformation

Now the nascent oxygen thus separatedfrom water is released into the atmosphere whichreactswithOxygenmoleculestoproduceOzone.

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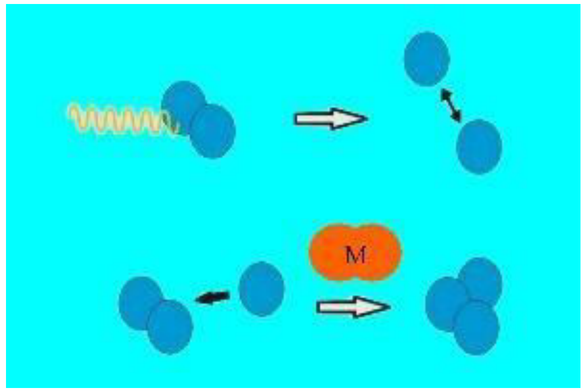

Fig7.4Ozoneformationcycle

Theprobabilityoftheformationofozone is around 30-40% in the open atmosphere.Theprobabilityislessbecausethenascentoxygen atom is unstable and it combines withother gasescompounds.

If the same reaction is made to take place in aclosedcontrolled environment at a temperatureof about 600-800^o C, the probability of formationincreases to 85-95% because the combination ofthe nascent oxygen with the other molecules isavoidedanditonlyreactswithoxygenatomalone.

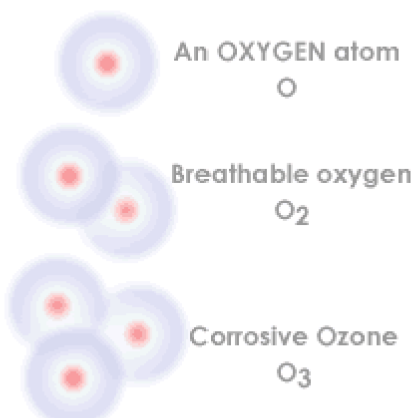

Fig7.5Oxygencompound

ADVANTAGES:

Theadvantagesofthe projectare

- ✓ Pollutionreduction
- ✓ Reducinghydrocarbonfuelusage

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- ✓ Ozonereplenishment
- ✓ Increasedefficiencyoftheengines

Pollutionreduction

Themajorpollutantssuchas Nitrousoxide, Carbon monoxide and Hydrocarbon levelsfall considerably. This is a great advantage of theproject;thesegasesareresponsibleformanyharmful effects on the environment and also onthehumankind.

Reducedhydrocarbonfuelusage

As we are going to add hydrogen as aadditionalfueltothecombustionchamberitreduces the amount of fuel required. The energydensity of hydrogen is high thus lesser amount offuel is sufficient for the production of the sameamountofthrust.

Ozonereplenishment

Thenascentoxygenatomreleasedcombines with oxygen molecule to form ozone.This replenishes the ozone layer at the same timereduces the pollution. This protects the humankind,thereplenishmentisdonequicklyotherwiseatnormaltimesitwilltakedecades.

Increasedengineefficiency

The injection of hydrogen increases thecombustorefficiencyandthusincreasestheengine efficiency. At ground level to oxygen canbe diverted into the combustion chamber whichwillboostup the engineefficiencyatwill.

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