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Investigations in Respect to Accidents of Airplanes

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ABSTRACT

The process of flying airplanes successfully is the result of a total of physical and chemical reactions at balance circumstances. As much as the processes are controlled properly, the flight occurs successfully. This research focuses on the physical properties of materials in different conditions that lead to changing their properties towards undesirable aspects and how to maintain the quality of the original properties of the material used in the airplanes by maintaining the conditions that the material needs to keep its original properties. We witnessed several airplane accidents and investigated their causes by investigating the conditions surrounding the airplane before and during the accident, focusing on the date and time of the accident to determine the atmospheric conditions such as temperature, air pressure, and air humidity, as well as the changes in torque generated in the wings during flight during the malfunction of one of the engines and efficiency jet engines, as well as contractions caused by the reduction in the temperature.

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Introduction

We often watch videos of accidents of airplanes jet engines malfunctioning which starts spitting fire showing that the spitting fire out of the engine is a mere indication of fuel leaking either from fuel tubes or even from the fuel injector of the failed jet engine, where it doesn't appear obviously due to rapidly evaporation in the heat of the engine and turbulence air storms at the output of the engine, while at this moment of bursting this released fuel got the ignition heat required accidentally, to appear as flames leap out of the engine, but even after this moment of flames the fuel leaking is on the action, to reduce the efficiency of the engine and rising the risks of the flight, observing airplane accidents, we found that most airplane accidents happen when the vertical axis of the airplane takes an angle of more than 45 degrees. The airplane has been designed to consider aerodynamic actions during the flight, but when the airplane takes a sharp angle, the rising power of the airplane will not be at the sufficient values to carry the weight of the airplane, where it will be less than the value of the effective force of gravity of the Earth; therefore, it fails down due to the gravity force of the Earth to the total mass of the airplane. Perhaps that happened during the flight due to pilot mistake or due to strong winds.

Factors should be Considers during the Flight

- **The Effect of the Operating Temperature:** Each material has specific chemical and physical properties; therefore, considering these properties could specify the operation temperature of machines and equipment to be running within the safe limits of operation, via guaranteeing the suitable coolant systems and ventilation around these equipment, in the meantime the operation process of these machines and equipment should be obliged by the limit capabilities and avoid exceeding the maximum limits of speed to avoid any accidents [1].
- **Flight Angle:** Increase the flight angle of the airplane by more than 45 degrees, where the airplane has been designed to consider aerodynamic actions during the flight, but when the airplane takes a sharp angle, the rising force of the airplane will not be at the sufficient values to carry the weight of the airplane, where it will be less than the value of the effective force of gravity of the Earth; therefore, it fails down due to the gravity force of the Earth to the total mass of the airplane. Perhaps that happened during the flight due to a pilot mistake or due to strong winds. Bank angle represents a rotation of the lift force around the velocity vector, which may indicate whether the airplane is turning, for instant when the pilot takes sharp angle to change the direction of flight, the airplane will take a sharp angle to the vertical axes, thus the lifting force of the airplane reduces extremely, where the gravity force of the Earth will overcomes the value of generated lifting force, and pull the airplane down, and at a low altitude (near the surface of the Earth), there will not be sufficient time to return the balance again even if he returns the angle to its regular value. , therefore, he shouldn't make a sharp turning angle during changing the direction of the airplane near the surface of the Earth to avoid the distortion of the balance of forces [2].
- **The Value of Generated Torque in the Wings as a Result of the Failure of One of the Engines:** In propeller-driven airplanes with twin or multi-engine counter-rotating installations, the propellers on the right wing turn counter-clockwise while those on the left wing turn clockwise, in order to provide a state of balance of the effects of propeller torque, thus eliminating any problems associated with a critical engine by equalizing the reaction forces of their torque with each other and providing a state of balance. Therefore, when

a partial or complete failure occurs in one of the engines, it causes confusion in the state of balance due to a decrease or absence of the reaction force of the (torque) the faulty engine, which leads to the activation of the reaction forces of (torque) the valid engine, in this case the pilot must be aware of identifying the faulty engine so that he can realize the direction of the reaction forces of (torque) the valid engine in order to determine the direction of rotation of the plane, and try to spin the plane by the ailerons and rudder pedal to turn airplanes to the opposite direction of the reaction forces of (torque) the valid engine, in this case, the speed of flight should be kept to minimum limits in order to reduce the reaction forces of (torque) of the valid engine and lead the plane to the nearest airport for an emergency landing [3].

- **The Pressure Magnitude in the Combustion Chamber:** Investigations should also check (the pressure magnitude of the air in the combustion chamber) because if the value of the pressure increases above the required level, it will push the fuel out of the combustion chamber before it does the required functions properly inside the combustion chamber, also acceleration the speed of the airplane quickly (quickly accelerate) will urge the fuel injector to inject a big value of fuel inside the combustion chamber, that will push some of the incomplete burned fuel to release from the output of the engine and form a cloud of hot steam of fuel around the engine, in the meantime the operating temperature of the jet engine should not be affected due to the reduced in the temperature of the air around, to keep the burning procedure goes properly. We often watch videos of jet engines malfunctioning and starting to spit fire, showing that the spitting fire out of the machine is a mere indication of fuel leaking either from fuel tubes or even from the fuel injector of the failed jet engine, where it doesn't appear obviously due to rapid evaporation in the heat of the engine and turbulence air storms at the output of the engine, while at this moment of bursting, this released fuel got the ignition heat required accidentally to appear as flames leap out of the machine, but even after this moment of flames, the fuel leaking is on the action to reduce the efficiency of the engine and raise the risks of the flight. This is why checking the value of the pressure of the air in the combustion chamber should take priority during the maintenance of the jet engines and prevent increasing the pressure of the required level to prevent pushing the fuel out of the combustion chamber before it does the required functions properly inside the burning chamber [4].
- **Acceleration Speed of the Airplane:** The pilot shouldn't accelerate the speed of the airplane quickly (quickly) to prevent injecting a large value of fuel inside the burning chamber, which may push some of the incompletely burned fuel to be released from the output of the engine to form a cloud of hot steam of fuel around the engine; the operation temperature of the jet engine should not be affected due to the reductions of the temperature of the air around it; therefore, the temperature of the jet engine should not be reduced more than the ideal operating temperature in order to keep the burning procedure inside the combustion chamber properly. Note that during the take-off of the airplane, there is no escape from injecting large amounts of fuel into the combustion chamber the jet engine should have an extra accessory for injecting air into the combustion chamber during the take-off, from the starting system to return the balance state between the injected fuel and injected air determined in the fuel combustion process in the combustion chamber, to avoid release non-burned fuel from the output of the jet engine, note that adding of some small grooves on the inner surface of the combustion chamber able to generate vortices to increase the possibility of colliding fuel particles and transfer them to the gas phase to be igniting quickly before their exit towards the outlet of the engine. These two points increase the efficiency of the engine to use the whole fuel in the combustion chamber for the purpose required and increase the safety of preventing spitting fire out.
- **Failure in the Landing Gear during the Landing:** This often happens due to drop the temperatures during flight, which leads to contractions in parts of landing gear, which leads them to lock on each other and the inability to move despite the operation of the hydraulic system, because each material has specific physical properties, therefore considering contraction of materials and secure the operation temperature to be running within the safe limits of operating temperature may avoid these contraction of materials of landing gear, where there are a many airplane accidents that happen during landing in airports due to the failure of the landing gear, but this issue could be resolved by designing a new part-able landing gear that should always be ready in the airports could represent a developed vehicle able to carry the weight of the airplane in the emergency cases to work instead of the nose gear or manager gear of the airplane if any failure occurs during the landing, and training drivers to ride them at a high speed to catch the airplane during the landing and make these part-able landing gear (developed vehicles) at a suitable place under the airplane in order to avoid any friction with the ground due to the loss of the original landing gear during the landing of the airplanes in the airports [5].
- **High Electric Resistance Wires:** Using high-electric-resistance wires for long distances and thermally isolated wires could increase the total value of the electric resistance of these wires and create a high rate of heat that can pose high risks to the safety of the airplane and cause fires in the construction of the airplane, which often occurs, especially during long periods of flight, where there is an opportunity for the accumulated generated heat of those thermally isolated wires to grow to dangerous levels in the thermally isolated environment of the construction of the airplane.
- **The Helicopter shouldn't Ever Try to Make the 360-Degree Roll during the Flight:** The unique flight operations which shouldn't ever the helicopter try to make it, is the 360 degree vertical rolling, because during the normal flight, the main rotor generates propulsion pressure towards the ground is equal to the gravity force of the Earth to the total mass of the helicopter, but when the helicopter attempts to do the 360 roll and at the moment of rolling and at the point when the helicopter became reversed exactly upside down, the total forces which will act upon the helicopter in the air is the gravity force of the Earth to the total mass of the helicopter plus the generated propulsion pressure of the main rotor, thus the effected forces upon the helicopter towards down will be at a double value and that will push the helicopter hardly towards down, while even after the righting the helicopter itself in the air, the main rotor will not be able to generate the required value of the propulsion pressure towards down is equal to the last record value of the generated force towards down which it's at a double value, thus the helicopter will lose the control during even after righting the helicopter itself in the air and will keep moving towards down severely and the flight will be ending with helicopter accidents, because the engine, engine

transmission and main rotor of the helicopter doesn't designed to reduce the generated propulsion pressure rapidly when the helicopter is at a reversed case upside down to reduce the total force towards down nor to increase the generated propulsion pressure towards down when the helicopter takes the righting itself in the air during the ordinarily flight, thus the helicopter will keep moves hardly towards down with no control, otherwise the engine, engine transmission and main rotor of the helicopter should be designed to be able to change the value of the generated propulsion pressure during the changes in the sorts of flights rapidly, but the main challenge in this issue is the momentum characteristics of the materials of the engine, engine transmission and main rotor of the helicopter as all rest of parts of the helicopter which will prevent changing their motions speeds rapidly therefore it's strongly recommended that the pilot of the helicopter should prevent to makes is a 360 degree vertical rolling to avoid any helicopter accidents. Some helicopters may succeed in completing this process if they were originally designed for this process, as they should be small in size and light in weight (made of fiberglass) and have large propellers. Here, a high momentum force will not be generated in the aircraft material, during the 360-degree vertical rolling the engines will be able to generate thrust pressure capable of restoring balance of the helicopter.

These are some investigations in respect to several accidents of airplanes

- **Technical Investigation of Accident of Boeing 737 Alaska Flight 1282 Left Portland:** When conducting any technical investigation for any incident, first determine the date, time, and place of the incident to know the surrounding conditions of that incident to identify the impact on the physical properties of the materials in that incident [6]. The accident occurred for Alaska flight 1282 that left Portland after 5 pm local time on Friday when a deactivated emergency door blew out at 16,000 feet (4877 meters). It's one of the coldest days of the year in a cold region, where the temperature in Portland is -8 degrees Celsius, and that drops more at higher altitudes (16,000 feet or 4877 meters), knowing that the drop in temperature at that altitude leads to a significant drop in atmospheric pressure that leads internal pressure of the airplane to overcome the mechanical forces that work to install the door. Briefly, we are dealing with two bodies: first is the body of the airplane, and second is the body of the door, and each of them has a different mass and volume when we calculate the rates of contractions of these two bodies via the formula [7]:

$$\Delta V = V_o . \alpha . \Delta T$$

ΔV is the change in the volume, α is the coefficient of thermal expansion, and ΔT is the change in the temperature of the matter. α = Coefficient of thermal expansion is equal to the change in the volume of a unit of mass under a 1ºC change in temperature. First, we find very wide differences in the input data of these two bodies; therefore, the result of the contraction rates of these two different bodies is extremely different. The frame body is completely different in the rate of contraction of the body of the door; this leads the internal pressure of the airplane to overcome the mechanical forces that install the door and push it outwards. The solution is to make the size of the door much larger than the size of the opening in the frame body of the airplane and to make the direction of opening the door towards the inside instead of towards the outside; thus the internal pressure of the airplane will increase the stability of the door. Note that this is the same reason for the incident of the Japan ANA Boeing 737-800 flight that turned back due to a cockpit window crack [8]. The severe contraction in the material of the body of the airplane in the cockpit is higher than the contraction of the material of the window (glass), which leads to generating a high pressure on the window material (glass) that leads to cracks in it.

- Finding Debris Inside the Fuel Tanks of the Airplanes: There are many reports indicating existing debris inside the fuel tanks of the airplanes, such as reports indicating Boeing finds debris in the fuel tanks of many undelivered 737 MAX jets, where nobody knows how this debris got its way into the fuel tank [9]. Still, studying this issue from the chemical reactions of the fuel, an additional chemical composition that is often added to the fuel (kerosene) to improve its features, the internal paint of the internal front of the tanks, and water of the atmosphere may result in solid crystals that may grow gradually to form as big pieces of debris inside, and fuel tanks could threaten the safety of the airplane. Often the source of this debris inside the tanks of planes may be due to the chemical reactions between the chemical active components, which may always be added to the kerosene to improve its features with the paint of fuel tanks to create new chemical components that have a hard and solid characteristic, to appear like debris insides the fuel tanks. Perhaps the used fuels in these airplanes are not unleaded kerosene; therefore, the metal lead in the fuel may crystallize gradually to form big crystals to be found in the tank as big metallic debris. Even the existence of the water in the fuel tanks, either which comes with fuel during the fuel production in the refinery or comes with the air during the charging of these tanks with fuel in the airports, may react with the iron of the tanks to create iron rust as big pieces of such debris inside the tanks.
- Investigate the Incident of Sparks Shooting the Jet Engine : This is one of incident of sparks shooting from a cargo plane of Atlas Air Boeing 747-8, and again we shall point out the date of the incident where it happened during the coldest days of the year and the highest humidity, the entered air into the engine is very cold and the time spent in the engine is very limited until it gets heated, expands, create pressure to the turbine blades and get out, the cold air absorbs big rates of heat of the fuel, big amount of fuel doesn’t get the required heat to be transferred to the gas phase and burned completely in that very short period in the jet engine, this leads to pushing great rates of not burned fuel outwards and accomplishing their burning outside (in the air) to appear as fires shooting from the engine [10].

Proposed Solutions

- Often malfunctioning jet engines started spitting fires out and this is merely an indication of fuel leaking, either from fuel tubes or from the combustion chamber, where it doesn't appear obvious due to rapid evaporation in the turbulence air at the output of the engine, at the moments of bursting the released fuel get the ignition heats accidentally, to appear as flames leap out of the engine, but even before these moments fuel leaking was on action reducing the efficiency of the engine rising the risks of the flight, while often these fires in broken engines remained and grow to dangerous stages, this means another failure occurred in stopping fuel injecting to the burning engines during these accidents.
- The pressure of air in the combustion chamber should take

priority during the testing of jet engines to be at the limits of the required level to grant the fuel sufficient time to be burned completely, where increasing air pressure extremely will push big amounts of not burned fuel from the output of the engine before it does its required functions in the combustion chamber.

- Accelerating the speed of an airplane quickly will urge the fuel injector to inject a bigger value of fuel inside the combustion chamber than the injected air for the burning function; otherwise, that will push big amounts of not-burned fuel from the output of the engine and form a cloud of hot fuel vapour around the engine; therefore, the acceleration of the speed should be quiet and soft because all technical operations need sufficient time to be achieved properly.
- The operating temperature should be guaranteed to each part of the airplane, especially in the winter when the temperature reduces in high altitudes; also, when the jet engine runs at less than operating temperature, it prevents combustion chambers from being operated properly and pushes big amounts of not burned fuel from the output of the jet engine, reducing the efficiency of the engine.

Investigate the Incident of Failure of the Different Gears of a Unit of Constant Speed (CDS) to be Twisted like Dough: A cooling system must be provided for the gearbox to release accumulated heat to prevent the temperature of gears from reaching 400 degrees Celsius so that the gears maintain the hard properties that have been obtained by specific heat treatments in the factory. Ensure that the lubrication system is in good condition and a viscosity level of used oil is suitable for these circumstances. Note that in the high speeds of spinning, the generated centrifugal force could push the oil away and reduce its effects in lubrication. Here it is preferred to fill the gearbox with oil to let all gears be immersed in the coolant oil and keep this level during the daily check. The specific heat treatment that has been done to the gears before assembling them in their gearbox makes them very hard (the iron becomes in the martensitic phase), where gears may be broken under high loads but do not bend nor become like dough unless the temperature of the gearbox rises to a high level, above 400 degrees Celsius. Where the martensitic phase starts to be cancelled and another phase starts to form a lower hardness. This means that there is a problem causing the rising temperature of the gearbox, which may come from the jet engine or somewhere else (note that if the life span of the used ball bearings to install gears in the gearbox has ended, here the ball bearings may represent the main resource of the gear's overheating); therefore, we pointed out the necessity of having a cooling system in the gearbox to prevent raising its temperature above 400 degrees Celsius [11].

Investigate the Incident of the Nepalese Plane (Yeti Airlines Flight 691 from Kathmandu to Pokhara in Nepal on 15 January 2023): In many twin- or multi-engine airplanes with counter-rotating propellers, the propellers on one wing turn clockwise, while those on the other wing turn counter clockwise. This is done to balance the effects of propeller torque. When one of the engines gets stopped, it can lead to an imbalance due to the absence of the torque on that side. The pilot may need to identify the faulty engine to counteract the effects and may need to use ailerons and rudders to control the airplane in the event of engine failure to create specific values for the spinning of the airplane equal to the torque of the active engine to reduce the imbalance and to fly towards the nearest airport for an emergency landing. Extreme angles (more than 45 degrees) can lead to a reduction in the rising force due to the aerodynamic actions of the flight making it difficult for the airplane to maintain flight because the airplane has been designed to consider aerodynamic actions during the flight, but when the airplane takes a sharp angle the rising power of the airplane will not be at the sufficient values to carry the weight of the airplane where it will be less than the value of the effective force of gravity of the Earth, the pilot should not increase the speed of the plane so as not to generate a large amount of torque in the engine active during the absence of torque in the broken engine and to use ailerons and rudder to create spinning equal to the generated torque of the active engine, if the pilot realizes that things are out of control he must empty the fuel into the air and prepare for the emergency landing to reduce the losses of life of passengers. There should be records to record the expected lifespan of each part in the airplane, the date it was installed, and the date it should be replaced with a new spare part before it fails during flight to avoid aviation accidents [12].

Important note: Developments should occur in the designs of jet engines so that the engine should maintain operating temperatures despite the sharp drop in air temperatures by controlling the amount of exiting air from the combustion chamber to reduce the rates of lost heat that exits with the rate of exhaust gases from the combustion chamber (especially in winter). To facilitate this task, there should be at least two different standards of diameter of the nozzle of the output of the combustion chamber. Where it should be smaller in the winter than its value in the summer, to reduce the lost heat with exiting air, in the meantime the speed and altitude of the flight in the winter should be lower rates than in the summer. Note that as much as the flight is at a higher altitude, the percentage of vapour increases in the air content (to 5 km altitude) [13] and a reduction in the air temperature increases the rate of heat loss from the combustion chamber. In the meantime, at high altitudes, a sharp reduction occurs in the density of air and the percentage of Oxygen content in the atmospheric components [14], which also reduces the efficiency of the jet engine. Therefore, the passenger airplane shouldn't fly to high altitudes in the cold winter to maintain the ideal conditions in the combustion chamber because it is the only part that maintains the operating temperature for all parts and components of the airplane.

Conclusion

Airplanes are among the equipment that are most exposed to stresses during the flight; therefore, regular maintenance should be carried out on them according to their specified schedules, and the records should be reviewed for the expected lifespan of each part and replaced before its expiration date to prevent its failure during the flight to avoid the occurrence of aviation accidents. Where many issues should be considered during operating the airplanes, such as the effect of the operating temperature, where it should be guaranteed to each part of the airplane, especially in the winter when the temperature reduces in high altitudes, also when the jet engine runs at less than operating temperature prevents combustion chambers from being operated properly and pushing big amounts of not burned fuel from the output the jet engine reducing the efficiency of the engine, because each material have specific chemical and physical properties, therefore considering these properties could specify the operation temperature of machines and equipment's to be running in the safe limits of operation, via guarantee the suitable coolant systems and ventilation around these equipment's, in the meantime the operation process of these machines and equipment's should obliged by the limit capabilities and avoid exceeding the maximum limits of speed to avoid any

accidents. The pressure of air in the combustion chamber should take priority during the testing of jet engines to be at the limits of the required level to grant the fuel sufficient time to be burned completely, where increasing air pressure extremely will push big amounts of not burned fuel from the output of the engine before it does its required functions in the combustion chamber. Accelerating the speed of an airplane quickly will urge the fuel injector to inject a bigger value of fuel inside the combustion chamber than the injected air for the burning function; otherwise, that will push big amounts of not-burned fuel from the output of the engine and form a cloud of hot fuel vapour around the engine; therefore, the acceleration of the speed should be quiet and soft because all technical operations need sufficient time to be achieved properly. The standards of entering air quantities into the combustion chamber should not be constant but rather variable and under control according to the air temperature of the atmosphere, there should be at least two different standards for the percentage of exiting air from the combustion chamber that should be adhered to during maintenance, so that the diameter of the nozzle in the winter should be smaller than its value in the summer to reduce the loss heat with exiting air to maintain the engine temperatures within the performance temperature limits, and the speed and altitude of the flight in the winter should be lower than its rates in the summer.

Dangerous manoeuvre when the pilot takes a sharp angle of flight where the lifting force of the airplane reduces extremely and the gravity force of the Earth overcomes to pull the airplane down, and there will not be sufficient time to return the balance again at a low altitude (near the surface of the Earth), even if he returns the angle to its regular value. This change in the value of the angle of the airplane occurs when the pilot turns the direction of the airplane; therefore, he shouldn't make a sharp turning angle during the changing of the direction of the airplane near the surface of the Earth to avoid the distortion of the balance of forces.

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