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JOURNAL OF INDIAN LEATHER TECHNOLOGISTS' ASSOCIATION (JILTA)

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JOURNAL OF INDIAN LEATHER TECHNOLOGISTS' ASSOCIATION (JILTA)

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We are entangled and endangered!!

Scientists from around the world had issued a dire "warning to humanity" with the version that humans had pushed Earth's ecosystems to their breaking point and were well on the way to ruining the planet. The warning listed environmental impacts like biblical plagues — stratospheric ozone depletion, air and water pollution, collapse of fisheries and loss of soil productivity, deforestation, loss of species and catastrophic global climate change caused by the burning of fossil fuels as well as unpredictable rainfall compounded with fight for river water throughout world. "If not checked," warned the scientists' community, led by particle physicist and Union of Concerned Scientists co-founder Henry Kendall, "many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know."

But things were only going to get worse. To mark the 25th anniversary of the issue of warning, researchers have issued a bracing follow-up once again. In a communiqué published very recently in the journal 'BioScience', more than 15,000 scientists from 184 countries assess the world's latest responses to various environmental threats. Once again, they find us sorely wanting waiting for finale with no undoing of our current practices. "Humanity has failed to make sufficient progress in generally solving these foreseen environmental challenges, and alarmingly, most of them are getting far worse," they have cautioned.

This warning, spearheaded by Oregon State University ecologist William Ripple, serves as a "second notice," the authors say: "Soon it will be too late to shift course away from our failing trajectory." Global climate change sits atop the new list of threat for planetary calamity. Global average temperatures have risen by more than half a degree Celsius since 1992, and annual carbon dioxide emissions have increased by 62 percent. But it is far from the only problem people do face across the world. Access to fresh water has declined, as has the amount of forestland and number of wild-caught fish (a marker of the health of global fisheries). The number of ocean dead zones has increased. The human population has got grown by a whopping 2 billion, while the populations of all other mammals, reptiles, amphibians and fish have declined by nearly 30 percent.

The lone bright spot exists way up in the stratosphere, where the hole in the planet's protective ozone layer has shrunk to its smallest size since 1988. Scientists do wish to award the credit that progress to the phasing out of chlorofluorocarbons — chemicals once used in refrigerators, air conditioners and aerosol cans that trigger reactions in the atmosphere to break down ozone."The rapid global decline in ozone depleting substances shows that we can make positive change when we act decisively," specifically the developed nations without imposing onus to the rapidly developing nations though China and India have got a bigger role to play herewith. The scientists have offered suggestions for reining in our impact on the planet, including establishing nature reserves, reducing food waste, developing green technologies and establishing economic incentives to shift patterns of consumption. In my opinion corruption is also a threat for the planet which cannot be done away with punishment but with awakening of consciousness for our next generation.

Dr. Ripple and his colleagues have formed a new organization, the Alliance of World Scientists, aimed at providing a science-based perspective on issues affecting the well-being of people and the planet.

"Scientists are in the business of analyzing data and looking at the long-term consequences," scientists have said in a release. Those who signed this second warning are not just raising a false alarm but the crude reality which if goes unheard and the society remains non respondent towards any remediation with bring down the catastrophe once in a while from the blue moon. They are acknowledging the obvious signs that we are heading down an unsustainable path though we do talk very frequently on sustainability.

Another unseen and untold catastrophe we are inviting by widespread use of antibiotics in poultry populations and inflated use of steroid laden food for fisheries. These are giving ample scope of culmination multi drug resistant microbial species and erosion of human species. Though it has come as good news for us that many international forums have pitched their voices in this particular aspect and few multinational meat selling platforms have already asked poultry raisers to stop abundant use of

antibiotics. But their position on Indian spectrum is not very clear as they have not given clear indication to Indian poultry raisers yet. We do hope that poultry and fishery products will also go through stringent bio medical tests before human consumption. Herbal alternative medicine laden food can be thought about and explored. When wild grazing animals can survive on consumption of specific medicinal herbs by their extra ordinary senses which nature has endowed them with, then why not the captivated poultry and fishery populations!!

We do hope that their message and our appeal will ignite a widespread public debate about the global environment and climate if not last but the least for our healthy next generation.

Goutam Mukherjee

Dr. Goutam Mukherjee
Hony. Editor, JILTA

From the Desk of General Secretary

Seminar in IILF – 2018, Chennai

You will remember our organizing seminars at Chennai during IILF – 2014, IILF – 2015 and IILF – 2016 which consisted of delivery of lectures on topics relevant to leather and allied industry by eminent personalities including felicitation of some individual / companies for their outstanding contribution to the Industry.

This year due to our being busy with organizing IULTCS Congress XXXIV jointly with CSIR – CLRI from 5th to 8th February at Chennai, we did not organize the 4th seminar on 2nd February – the second day IILF – 2017 as during the previous three years.

For the 4th seminar at Chennai we have already booked Seminar Hall 'A' from 10.00 Hrs. on 2nd February, 2018 – the second day of IILF – 2018.

Verbal consent has been received from Dr. B. Chandrasekaran, Director, CSIR – CLRI, Chennai & Prof. (Dr.) Sanjoy Chakraborty, Principal, GCELT, Kolkata for delivering lecture at the 4th seminar and from Mr. N. Shafeeq Ahmed, Chairman, Indian Finished Leather Manufacturers & Exporters Association to grace the occasion as the Guest of Honour.

17th Sanjoy Sen Memorial Lecture

Above is normally organized every year on 14th January – the birthday of our late President Sanjoy Sen.

Next year 14th January falls on a Sunday. The names of the newly elected Executive Committee Members of ILTA for the term 2017-2019 will be announced formally by the Returning Officer in the 59th AGM scheduled to be held at 03.00 PM on Thursday the 30th November, 2017 at the auditorium of Indian Science Congress Association.

The newly elected executive committee is likely to have its 1st meeting earliest in the first week of December, 2017 when they will decide taking various factors into consideration, whether the lecture will be organized on Sunday the 14th January, 2018. We will accordingly let you know through individual invitation card on the date, time and venue of 17th Sanjoy Sen Memorial Lecture along with the name of the person who will be delivering the lecture and the title of the same.

LEXPOs in 2017 – 2018

As intimated in October, 2017 issue of JILTA, we formally communicated to the competent authorities for allocation of ground for organizing LEXPOs as per schedule given below :-

a. Kolkata LEXPO – XXXXI : 4th Nov, 2017 to 19th Nov., 2017
b. Durgapur LEXPO – V : 2nd Dec., 2017 to 17th Dec., 2017
c. Siliguri LEXPO – XXIV : 20th Jan., 2018 to 4th Feb., 2018

Except for Durgapur, no feedback received. Confirmation of allocation of ground at Durgapur in response to our letter dated 16/09/2017 received too late to be able to organize LEXPO there from 2nd Dec., 2017. The competent authorities informed accordingly. Hence LEXPO at Durgapur is unlikely to be organized this financial year.

You are requested to :-

a) Kindly inform us your '**E-Mail ID**', '**Mobile No**', '**Phone No**', through E-Mail ID: admin@iltaonleather.org or over Telephone Nos. : 24413459 / 3429 / 7320. This will help us to communicate you directly without help of any outsiders like Postal Department / Courier etc.

b) Kindly mention your **Membership No. (If any)** against your each and every communication, so that we can locate you easily in our record.

(Susanta Mallick)
General Secretary

Executive Committee Members meet every Thursday at 18-30 hrs. at ILTA Office.
Members willing to participate are most welcome.

STEALTH TECHNOLOGY

Mahfooz Ali Akbar[1] & Dr. Goutam Mukherjee[2]

GOVERNMENT COLLEGE OF ENGINEERING AND LEATHER TECHNOLOGY, KOLKATA

ABSTRACT :

Stealth refers to the act of trying to hide or evade detection. Stealth technology is ever increasingly becoming a paramount tool in battle especially "high technology wars" if one may occur in the future where invincibility means invincibility. Able to strike with impunity, stealth aircraft, missiles and warships are virtually invisible to most types of military sensors. The experience gained at the warfront emphasizes the need to incorporate stealth features at the design stage itself. According to conventional military wisdom, surprise is the best form of attack. With evermore sophisticated methods of detection, however, catching the enemy unawares has becoming increasingly difficult thus paving way to the development of increasingly sophisticated technologies that help in evading the enemy's ever vigilant "eyes". Stealth Technology essentially deals with designs and materials engineered for the military purpose of avoiding detection by radar or any other electronic system. Stealth, or anti detection, technology is applied to vehicles (e.g., tanks), missiles, ships, and aircraft with the goal of making the object more difficult to detect at closer and closer ranges thus providing an element of surprise in the attacks. Attacking with surprise gives the attacker more time to perform its mission and exit before the defending force can counterattack. For example, If a surface to air missile a type of antiaircraft battery defending a target observes a bomb falling and surmises that there must be a stealth aircraft in the vicinity it is still unable to respond if it cannot get a lock on the aircraft in order to feed guidance. As stated earlier stealth technology can be looked upon as a perfect blend between the engineering skills of "designing" and "technology". And for attaining stealth various detection techniques have to be surpassed

INTRODUCTION :

Stealth technology also known as LOT (Low Observability Technology) is a technologies which covers a range of techniques used with aircraft, ships and missiles, in order to make them less visible (ideally invisible) to radar, infrared and other detection methods. From the late years of World War II to today's computer enabled design changes, stealth has been a major factor in the improvement of reconnaissance and attack aircraft. The term "stealth", is thought to have been coined in 1966 by Charles E. "Chuck" Myers, combat pilot and later an exec at Lockheed. When we think of stealth today, immediately images of the B-2 bomber or the F-117A Nighthawk fighter comes to mind. In simple terms, stealth technology allows an aircraft to be partially invisible to Radar or any other means of detection. This doesn't allow the aircraft to be fully invisible on radar. Stealth technology cannot make the aircraft invisible to enemy or friendly radar. All it can do is to reduce the detection range or an aircraft. This is similar to the camouflage tactics used by soldiers in jungle warfare. Unless the soldier comes near you, you can't see him. Though this gives a clear and safe striking distance for the aircraft, there is still a threat from radar systems, which can detect stealth aircraft. Stealth technology is expanded into each of those areas which seek to detect the aircraft, ships & missiles. Thus it is essential to develop visual, infrared acoustic and radar stealth. However many countries have announced that they have developed counter-stealth techniques that allow them to negate stealth.

STEALTH TECHNOLOGY

"Oh divine art of subtlety and secrecy! Through you we learn to be invisible, through you inaudible and hence we can hold the enemy's fate in our hands." Sun Tzu – Chinese General, The Art of War, c.490 B.C. Stealth technology also known as LO technology (low observable technology) is a sub discipline of military electronic countermeasures which covers a range of techniques used with aircraft, ships, submarines, and missiles, in order to make them less visible (ideally invisible) to radar, infrared, sonar and other detection methods.

STEALTH PRINCIPLES

Stealth technology (or LO for "Low Observability") is not a single technology. It is a combination of technologies that attempt to greatly reduce the distances at which a vehicle can be detected; in particular radar cross section reductions, but also acoustic, thermal, and other aspects. Stealth technology aims at minimizing signatures and

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signals, and prevent/delay detection and identification, thus increasing the efficiency of the vehicles own countermeasures and sensors. Ben Rich, the leader of the Lockheed team that designed the F117, pretty much sums up stealth technology when he say: "A stealth aircraft has to be stealthy in six disciplines: radar, infrared, visual, acoustic, smoke and contrail. If you don't do that, you flunk the course." However, not all disciplines are equally important when discussing any given platform category. Underwater warfare will naturally hand dominance to the acoustic spectrum. However, land combat will emphasize visual, infrared and acoustic signatures. Radar and infrared bands dominate the scene of airspace surveillance.

THE TERM 'SIGNATURE' OF A VEHICLE

Signature - Any unique indicator of the presence of certain materiel or troops; especially the characteristic electronic emissions given off by a certain type of vehicle, radar, radio, or unit. Thus Signature can be concluded as any activity or radiation or the characteristic of the body that helps to revile its presence at a particular point. All the detection methods used that be in military and civil systems are by detecting the signature of the body. This signature is called by different names in different contexts. Radar Signature is called Radar Cross Section or RCS and so on. Thus signature can be rightly called as observability of an object and stealth vehicles can be called as low-observable vehicles or low-signature vehicles.

WHAT'S THE NEED FOR STEALTH TECHNOLOGY ?

It's a matter of fact that the rapid development of stealth technology occurred due to the pronounced improvement of the detection techniques like radar's as they were the most commonly used detection methods in the 1930's & 40's. There are some key strategies that triggered the development of the Stealth technology like the use of Radar Aided-Anti aircraft systems and the use of Sonar's for detecting the Submarines by the Ships etc. Thus the rapid development was the need of time to reduce causalities. And that still remains so. As Stealth technologies touching new heights day by day in the other side Anti-Stealth technologies are also in full momentum to outdate the Stealth technologies.

HISTORY OF STEALTH TECHNOLOGY

In the late 1930's and 1940's Radar technology was commonly used for detecting aircrafts. Since radar technology was developed during the Second World War, it should not be surprising to learn that the first attempts at stealth technology occurred during this period also. It might be surprising to learn, however, that it was the Germans, not the Allies, who worked on the project. The Germans were responding to the success the Allies were having with the early radar sets. Not only was their radar very effective at spotting incoming enemy bombers, but it was also very important in the battle for the Atlantic. The Germans developed a radar absorbing paint. While this ferrite-based paint was much too heavy for aircraft, it could be used on submarines.

The United States' first stealth development was totally accidental and quickly forgotten. Shortly after the war, Northrop Aircraft developed an experimental bomber called the YB-49 Flying Wing. As the name implies, the aircraft had no body or tail; it was simply a large flying wing. The aircraft was assigned to perform a normal test flight over the Pacific. When the test was completed, they turned and headed for home, pointing the slim wing edge directly at the base radar station. The radar crew was shocked to see the aircraft suddenly appear almost overhead because they had seen no evidence of it on the radar screen. Interest in the project quickly faded after the bomber crashed in the Mojave Desert in 1948. The plane was very unstable in flight and this stability problem was listed as the cause of the crash. With the "cold war" and the Soviet Union well under way in the early 1950s, it became imperative that the U.S. should learn about military developments deep inside the country. Old bombers were converted to spy planes, but they soon proved to be very vulnerable to attack. In order to plug this intelligence gap, a new plane was designed. The idea was to create a plane that could cruise safely at very high altitudes, well out of the reach of any existing fighter. The design specification required that "consideration is given…to minimize the delectability by enemy radar."

The task of making this plane a reality fell upon the Advanced Development Projects team at Lockheed in California. This was a small team of highly qualified and highly motivated engineers and pilots. This highly secret facility became known as the "Skunk Works" and has been on the leading edge of stealth technology since the early 1950s. The aircraft they developed became known as the U-2, and it was highly successful. After much effort they were successful in building an aircraft that could evade the enemy. There is a boat the Skunk Works developed shortly after the F-117A. It is called the "Sea

Shadow" and was built in 27 months and operated secretly in the late 1980 for $200 million dollars. The Sea Shadow was first unveiled on April 9, 1993. The barge used for the program was the Hughes Mining Barge (HMB-1), a vessel was originally built for a secret CIA project in the early '70s, and had been in mothballs for years. The CIA project, it has since come out, was an attempt to recover a Soviet nuclear sub that sank off the coast of Hawaii in 1968. The project included two ships, the Gosimir Explorer which was basically a ship capable of deep Sea mining, and the HMB-1 which actually submerged under the Gosimir Explorer. The HMB-1 had a claw to retrieve the USSR submarine, which was operated by the drill on the Gossimir Explorer. (The operation was partially successful with half of the ill-fated Soviet sub and crew being brought up from the ocean bottom.) The Sea Shadow's stats are: Length: 160 ft. Width: 68 ft. Draft: 14.5 ft. Displacement: 560 tons (full load). In May 1999, the Sea Shadow was reactivated by the Navy for a 5 year program in order to "research future ship engineering concepts and to serve as a host vessel for companies to demonstrate advanced naval technologies." The Sea Shadow is currently operation out of San Francisco Bay. Sweden that gave us Volvos, Saabs and ABBA has developed what it claims is the world's first fully operational stealth warship that is essentially invisible to radar. The two Visby-class corvettes will enter service by the end of the year. They are made from composite materials and use Rolls-Royce water jets to make them electronically undetectable at more than eight miles in rough seas and more than 14 in calm waters. The ship's acoustic and optical signatures are lowered by its non-magnetic hull that, like the F-117 Nighthawk, features large, flat surfaces and sharp angles. The water jets are 10 to 15 decibels quieter than propellers. "It's very hard for a submarine to detect a water jet vessel," Patric Hjorth, technical manager of the Swedish Defense Materiel Administration "It has a very different signature from a propeller-driven craft as it fades into the background."

DETECTION METHODS AND THE FIELDS USED

- RCS: - Aircrafts, Missiles, Ships, Land Vehicles...
- Infrared signature:-Aircrafts, Missiles, Ships, Land Vehicles, Submarines.
- Acoustic Signature: - Predominantly for Submarines (SONAR), Ships, Aircrafts etc.
- Visible Signature: - Predominantly for Land Vehicles, Aircrafts, and Ships.
- Laser Cross Section:-Aircrafts, Missiles, Ships, Land Vehicles.
- Magnetic Signature: - Submarines, Ships.

RADAR

In the early 1930's and 1940's radar technology was increasingly used to detect aircrafts. During the Second World War all counters Germany, Great Britain, France and The United States of America used this technology for navigating ships and to detect approaching enemy aircrafts. This technology didn't pose much of a threat then as this was not incorporated into Antiaircraft defence then. This whole story changed during The Vietnam and Yom Kipper wars to make the feet more secure for use and more effective the Americans who were the sheet anchor needed to develop an effective way to evade radar.

RADAR (Radio Detection And Ranging)

Thus RADAR as it is abbreviated so uses radio waves for detection of the target. Radar basically works on two major principles.

Echo

Echo can be considered as a wave bouncing off a surface and coming back to the source. This Principle can be applied for all types of waves starting from sound waves to light waves. The time for the reception of the transmitted signal to reach the transmitter cum receiver can be effectively used to calculate the distance of the target from the transmitter.

The Doppler Shift

This is the second principle of the radar. This effect is more commonly felt for sound. The sound that you hear as a vehicle is approaching you is at a higher pitch or a higher frequency than the sound you hear when the vehicle is moving away from you. This property when applied to radar can be used to determine the speed of the object. The frequency of the reflected wave can be the same, greater or lower than the transmitted radio wave. If the reflected wave frequency is less then this means that the target is moving away from the transmitter and if higher then moving close to the transmitter and if constant then the target is not moving like a helicopter hovering at a point. This can be used to predict the speeds of the target too.

Why Radio waves and not sounds waves ?

Although the above said principles are applicable to sound waves radio waves are used for detection and ranging due to the following reasons. The speeds of the radio waves are comparable with that of light and are much higher than that of sound. Sound waves cannot travel as far as light in the atmosphere without significant attenuation. And finally, electromagnetic echo is much easier to detect than a sound echo.

Radar Cross Section (RCS)

Radar cross section is the measure of a target's ability to reflect radar signals in the direction of the radar receiver, i.e. it is a measure of the ratio of backscatter power per steradian (unit solid angle) in the direction of the radar (from the target) to the power density that is intercepted by the target.

The RCS of a target can be viewed as a comparison of the strength of the reflected signal from a target to the reflected signal from a perfectly smooth sphere of cross sectional area of $1m^2$ as shown in Figure. The conceptual definition of RCS includes the fact that not all of the radiated energy falls on the target. A target's RCS ***(σ)*** is most easily visualized as the product of three factors :

σ* = Projected cross section x Reflectivity x Directivity.** Reflectivity: The percent of intercepted power reradiated (scattered) by the target. Directivity: The ratio of the power scattered back in the radar's direction to the power that would have been backscattered had the scattering been uniform in all directions (i.e. isotropically). For a sphere, the RCS, ***σ = ðr2 , where ***r*** is the radius of the sphere.

The RCS of a sphere is independent of frequency if operating at sufficiently high frequencies where *λ* < <Range, and *λ* < < radius *(r).* Experimentally, radar return reflected from a target is compared to the radar return reflected from a sphere which has a frontal or projected area of one square meter (i.e. diameter of about 44 inches). Using the spherical shape aids in field or laboratory measurements since orientation or positioning of the sphere will not affect radar reflection intensity measurements as a flat plate would. The sphere is essentially the same in all directions. The flat plate has almost no RCS except when aligned directly toward the radar. The corner reflector has an RCS almost as high as the flat plate but over a wider angle, i.e., over 60^o. The return from a corner reflector is analogous to that of a flat plate always being perpendicular to your collocated transmitter and receiver. Targets such as ships and aircraft often have many effective corners. Corners are sometimes used as calibration targets or as decoys, i.e. corner reflectors. An aircraft target is very complex. It has a great many reflecting elements and shapes. The RCS of real aircraft must be measured. It varies significantly depending upon the direction of the illuminating radar.

Significance of the Reduction of RCS

If each of the range or power equations that have an RCS (*σ*) term is evaluated for the significance of decreasing RCS, Therefore, an RCS reduction can increase aircraft survivability.

The equations used are as follows :

Range (radar detection):2-way range equation: ***Pr = Pt Gt Gr λ 2 σ*** :Thus, ***R4 α σ*** or ***σ 1/4 α R(4ð)3 R4***

Range (radar burn-through) :

Crossover equation :

RBT 2 = Pt Gt σ : Thus,***RBT 2 α σ*** or ***σ 1/2α RBT Pj Gj 4ð***

Power (jammer) : Equating the received signal return ***(Pr)*** in the two way range equation to the received jammer signal ***(Pr)*** in the one way range equation, the following relationship results :

Pr = Pt Gt Gr λ 2 σ = Pj Gj Gr λ 2 (4ð)3 R4 (4ðR)2

Therefore, ***Pj α σ*** or ***σ α Pj*** Note: jammer transmission line loss is combined with the jammer antenna gain to obtain ***Gt.***

Thus the Deductions can be made from the figure given below. This shows an example of
the effects of RCS reduction.

Thus if the RCS of an aircraft is reduced to 0.75 (75%) of its original value, then the jammer power required to achieve the same effectiveness would be 0.75 (75%) of the original value (or -1.25 dB). Likewise, If Jammer power is held constant, then burn-through range is 0.87 (87%)

of its original value (-1.25 dB), and the detection range of the radar for the smaller RCS target (jamming not considered) is 0.93 (93%) of its original value (-1.25 dB)

RADAR STEALTH

There are two broad aspects of RCS minimization techniques. One falls under the effort to restructure the frame, and covers the geometric design considerations that are taken into account when aiming for a low RCS. The other principle is referred to as "radar absorbent materials" and is concerned with the materials that help to reduce the reflectivity of the airframe, as well as the structures that will support these materials and integrate them into the airframe often referred to as "Radar-absorbent structures". These two axes are of course not taken in isolation during the design; trade-offs often have to be made between them.

Vehicle Shape

The stealth designer's mission starts with the same words as the physician's Hippocratic Oath: "First, does no harm." The prime most concern being that of the aircraft's The possibility of designing aircraft in such a manner as to reduce their radar cross-section was recognized in the late 1930s, when the first radar tracking systems were employed, and it has been known since at least the 1960s that aircraft shape makes a significant difference in detectability. The Avro Vulcan, a British bomber of the 1960s, had a remarkably small appearance on radar despite its large size, and occasionally disappeared from radar screens entirely. It is now known that it had a fortuitously stealthy shape apart from the vertical element of the tail. On the other hand, the Tupolev 95Russian long range bomber (NATO reporting name 'Bear') appeared especially well on radar. It is now known that propellers and jet turbine blades produce a bright radar image; the Bear had four pairs of large (5.6 meter diameter) contra-rotating propellers. Another important factor is the internal construction. Behind the skin of some aircraft are structures known as re-entrant triangles. Radar waves penetrating the skin of the aircraft get trapped in these structures, bouncing off the internal faces and losing energy. This approach was first used on the F-117.

The most efficient way to reflect radar waves back to the transmitting radar is with orthogonal metal plates, forming a corner reflector consisting of either a dihedral (two plates) or a trihedral (three orthogonal plates). This configuration occurs in the tail of a conventional aircraft, where the vertical and horizontal components of the tail are set at right angles. Stealth aircraft such as the F-117 use a different arrangement, tilting the tail surfaces to reduce corner reflections formed between them. A more radical approach is to eliminate the tail completely, as in the B-2 Spirit. In addition to altering the tail, stealth design must bury the engines within the wing or fuselage, or in some cases where stealth is applied to an existing aircraft, install baffles in the air intakes, so that the turbine blades are not visible to radar. A stealthy shape must be devoid of complex bumps or protrusions of any kind; meaning those weapons, fuel tanks, and other stores must not be carried externally. Any stealthy vehicle becomes non stealthy when a door or hatch is opened. Stealth airframes sometimes display distinctive serrations on some exposed edges, such as the engine ports. The YF-23 has such serrations on the exhaust ports. This is another example in the use of re-entrant triangles and plan form alignment, this time on the external airframe. Ships have also adopted similar techniques. The Visby corvette was the first stealth ship to enter service, though the earlier Arleigh Burke class destroyer incorporated some signature reduction features. In designing a ship with reduced radar signature, the main concerns are radar beams originating near or slightly above the horizon (as seen from the ship) coming from distant patrol aircraft, other ships or sea-skimming anti ship missiles with active radar seekers. Therefore, the shape of the ship avoids vertical surfaces, which would perfectly reflect any such beams directly back to the emitter. Retro-reflective right angles are eliminated to avoid causing the *cat's eye* effect. A stealthy ship shape can be achieved by constructing the hull and superstructure with a series of slightly protruding and retruding surfaces. This design was developed by several German shipyards, and is thus extensively applied on ships of the German Navy.

Coatings and Absorbers RAMs (Radar Absorbing Materials)

Radar-absorbing materials (RAMs) are used to dissipate the energy of the radar wave so to prevent the reception of a reflected signal by an antenna. Usually, the dissipation process converts the radio frequency (RF) energy to a negligible quantity of heat.

RADAR scattering due to vehicle shape

RAMs are one of four ways of reducing the radar cross-section of an object, which is a measure of the reflection of radar waves by an object. A larger radar cross-section

(RCS) of an object corresponds to a longer detection range and a higher signal-to-noise ratio for the observing radar operator. A 747 would have a huge RCS, whereas a bumblebee would have an insignificant RCS. Other ways of reducing RCS include passive cancellation, incorporating an echo source which by design cancels another echo source for a certain frequency and angle, active cancellation, incorporating a sensor and emitter which cooperate to radiate waves which interfere with incident radar waves, and by geometric shaping and design modifications. Only the last will be discussed, as the former two are rather impractical and are less dependent on material or process properties. Dielectric and magnetic RAMs are the two main types (along with various combinations of these) of RAMs in current operational use; these will be explored in further detail as we go along.

Types of RAMs

(i) Iron ball paint

One of the most commonly known types of RAM is iron ball paint. It contains tiny spheres coated with carbonyl iron or ferrite. Radar waves induce molecular oscillations from the alternating magnetic field in this paint, which leads to conversion of the radar energy into heat.

The heat is then transferred to the aircraft and dissipated. The iron particles in the paint are obtained by decomposition of iron pentacarbonyl and may contain traces of carbon, oxygen and nitrogen.A related type of RAM consists of neoprene polymer sheets with ferrite grains or carbon black particles (containing about 30% of crystalline graphite) embedded in the polymer matrix. The tiles were used on early versions of the F-117A Nighthawk, although more recent models use painted RAM. The painting of the F- 117 is done by industrial robots with the plane covered in tiles glued to the fuselage and the remaining gaps filled with iron ball paint. The United States Air Force introduced a radar absorbent paint made from both ferrofluidic and non-magnetic substances. By reducing the reflection of electromagnetic waves, this material helps to reduce the visibility of RAM painted aircraft on radar.

(ii) Foam absorber

It is used as lining of anechoic chambers for electromagnetic radiation measurements. This material typically consists of fireproofed urethane foam loaded with carbon black, and cut into long pyramids. The length from base to tip of the pyramid structure is chosen based on the lowest expected frequency and the amount of absorption required. For low frequency damping, this distance is often 24 inches, while high frequency panels are as short as 3-4 inches. Panels of RAM are installed with the tips pointing inward to the chamber. Pyramidal RAM attenuates signal by two effects: scattering and absorption. Scattering can occur both coherently, when reflected waves are in-phase but directed away from the receiver, and incoherently where waves are picked up by the receiver but are out of phase and thus have lower signal strength. This incoherent scattering also occurs within the foam structure, with the suspended carbon particles promoting destructive interference. Internal scattering can result in as much as 10dB of attenuation. Meanwhile, the pyramid shapes are cut at angles that maximize the number of bounces a wave makes within the structure. With each bounce, the wave loses energy to the foam material and thus exits with lower signal strength.[4] Other foam absorbers are available in flat sheets, using an increasing gradient of carbon loadings in different layers.

(iii) Jaumann absorber

A Jaumann absorber or Jaumann layer is a radar absorbent device. When first introduced in 1943, the Jaumann layer consisted of two equally-spaced reflective surfaces and a conductive ground plane. One can think of it as a generalized, multi-layered Salisbury screen as the principles are similar. Being a resonant absorber (i.e. it uses wave interfering to cancel the reflected wave), the Jaumann layer is dependent upon the $\lambda/4$ spacing between the first reflective surface and the ground plane and between the two reflective surfaces (a total of $\lambda/4 + \lambda/4$). Because the wave can resonate at two frequencies, the Jaumann layer produces two absorption maxima across a band of wavelengths (if using the two layers configuration). These absorbers must have all of the layers parallel to each other and the ground plane that they conceal. More elaborate Jaumann absorbers use series of dielectric surfaces that separate conductive sheets.

The conductivity of those sheets increases with proximity to the ground plane. Iron ball paint has been used in coating the SR-71 Blackbird and F-117 Nighthawk, its active molecule is made up by an iron atom surrounded by five carbon monoxide molecules.

Iron ball paint (paint based on iron carbonyl) a type of paint used for stealth surface coating.

The paint absorbs RF energy in the particular wavelength used by primary RADAR.

Chemical formula: C_5FeO_5 / $Fe(CO)_5$

Molecular mass: 195.9 g/mol

Apparent density: 76.87 g/cmc

Molecular structure: An Iron atom surrounded by 5 carbon monoxide structures (it takes a ball like shape, hence the name)

Melting point: 1536° C

Hardness: 82-100 HB

It is obtained by carbonyl decomposition process and may have traces of carbon, oxygen and nitrogen. The substance (iron carbonyl) is also used as a catalyst and in medicine as an iron supplement however it is toxic. The painting of the F-117 is done by industrial robots however the F-117 is covered in tiles glued to the fuselage and the remaining gaps filled with iron ball paint. This type of coating converts the radar wave energy into heat (by molecular oscillations) the heat is then transferred to the aircraft and dissipated. It is the exact same principle by which water is heated in the microwave oven (radar uses microwaves).

INFRARED (IR)

Passive IR detection techniques rely on the fact that every atom of matter continuously sends electromagnetic radiation at an IR wavelength which corresponds to its temperature. IR detectors identify an aircraft by discriminating its IR radiation with that of the background; hence it is desirable to have an IR emission from the aircraft close to the background radiation. Since controlling an IR emission during a Military operation is not always feasible; IR emission control has to be incorporated at the design stage of the aircraft itself. The major IR signature contributors are the airframe, engine casing and the plume. The amount of incident IR radiation in the detector's band depends upon the amount of radiation emitted by the source, its position with respect to the detector, and the amount of radiation that is attenuated (absorbed and scattered) by the atmosphere on its way to the detector. It is not possible to always operate in a position that results in minimum amount of incident IR on the detector in its band. Also it is not possible to control the amount of atmospheric attenuation of the IR emitted by the source in the direction of the detector. Hence the only operation that remains is to control the IR intensity emitted by the source. Infrared Signatures Suppression Systems (IRSS) like Black Hole Ocarina, Film cooled tail pipe and Centre Body tail pipe; are some of the popular IR countermeasures adopted. Further, in order to avoid IR seeking missiles, countermeasures such as infrared jamming systems, infrared flares or decoys are frequently employed.

Thermal Radiation

The total amount of radiation emitted is dependent on emissivity and the fourth power of
absolute temperature as given by Stefan Boltzmann Law, $e = \varepsilon . \sigma . T4$, where, Stefan Boltzmann constant, σ = 5.67 x 10-8 W/m2K4

From electromagnetic considerations, Planck's Law gives the monochromatic emissive power of a black surface as $eb\lambda = 2\eth C1\ \lambda 5[e(C\ 2\ /\lambda T)-1]$ where C1 and C2 are constants whose values are 0.596 x 10-16 W/m2 and 0.014387mK respectively.

For a non black surface, monochromatic emissive power is given by, $e\lambda = \varepsilon\lambda\ .\ eb\lambda$ The emissive power within a specified band of wavelengths is obtained by integrating the Planck's law within that wavelength interval. The total radiant emittance increases rapidly with temperature. The wavelength of maximum spectral radial emittance shifts towards shorter wavelengths with the increase in temperature. Individual curves never cross one another and hence higher the temperature, higher will be the radial emittance at all wavelengths.

Generalized IR System

Every typical IR system's components are designed to optimize the system performance for a specific wavelength region, for maximum detectivity, for high

resolution, and so on, depending upon the type of source to be detected and the kind of information the system is required to furnish. Consider a model of a generalized IR system, in order to help us understand the principles underlying the many IR systems. Every IR system model is composed of basic building blocks and every IR system whether active or passive, is composed of most if not all of these building blocks. For example, all IR systems include a source or target, a background, an atmosphere or environment, optics and a detector. With the aid of this generalized model, the path of IR radiation from its sources can be analyzed, step – by – step through the various modifications necessary for its final presentation in some form of display

INFRARED STEALTH

The passive IR sensors detect energy emitted by the aircraft. Since radiation from the aircraft cannot be avoided, the signatures have to be reduced or modified to match with the background in order to increase the probability of the success of the mission. Infrared Signature Suppression system.

Black Hole Ocarina (BHO) IRSS system

The Black Hole Ocarina IRSS has the advantage of optical blocking hot engine parts, and cooling exhaust duct and plume. The Black Hole System is a finned nozzle with internal bends to prevent the direct view of hot internal exhaust surfaces as shown. The bending of the nozzle avoids the direct line of sight of hot engine parts. Ocarina is a system of multiple exhausts is devised to dissipate the exhaust plume and reduce the plume radiation. Both, Black Hole system and Ocarina system have been merged to make the Black Hole Ocarina, which has the advantages of a bent nozzle of a black hole system and the multiple outlets of an ocarina system. The nozzle acts as an optical block for the direct view of the hot engine parts, and the multiple exhausts with the ejector system cools the plume as well as dissipates the plume so that the plume radiation is reduced. The hot exhaust air sucks in the cold air from the engine compartment and reduces plume temperature. The external air passing over the finned nozzle cools it.

Film Cooled Tailpipe (FCT) IRSS system

Film cooled tailpipe (FCT) entrains secondary air by ejector action for cooling the hot tailpipe and plume. This is a passive system depending on the static pressure distribution along the length of the device to draw ambient air. The FCT was designed to be a "mission kit", and as such is easily retrofit able with the aircraft's factory exhaust without any modifications to the aircraft. As shown in the Figure. FCT consists of a nozzle, a flow wedge down the stream of the nozzle and film cooling slots for cold air entry. Due to ejector action, cold air enters through the film cooling slots and cools the exhaust air. FCT provides passive cooling of both metal and plume.

The FCT needs minimum modifications on helicopter for installation and it is moderately effective in all flight conditions. The reported engine power loss due to FCT installation is of the order of 2% of maximum engine power.

Near Infrared Absorbing (NIR) Materials

Organic solids and polymers that absorb in the near-infrared (NIR) region (1000–2000 nm) represent a class of emerging materials and show a great potential for use in photonics, telecommunications. The radical anions of stacked aromatic imides, fused phorphyrin arrays, polythiophenes,sandwich-type lanthanide bisphthalocyanines, semiquinones, and mixed - valence binuclear metal complexes are a few known examples of NIR-absorbing organic materials. Most of these NIR-absorbing materials are also electrochemically active or electrochromic (EC). NIR-absorbing organic materials are low bandgap materials (e.g., 0.75 eV or 1550 nm) and thus must contain an extended conjugation or mixed valence system. Organic materials that are electrically, optically, or thermally active in the NIR region, specifically at the telecommunication wavelengths (e.g., 1310 and 1550 nm) can in principle be used in a device for optical attenuation and absorption or antireflection, owing to their unique electrical and optical properties, low-cost fabrication, and feasibility for use in a monolithically integrated optical device.

NIR-Absorbing Inorganic Materials

Metal oxides such as tungsten oxide (WO_3), IrOx, and Ta_2O_5 have been known for many years to be EC in the visible region and have been extensively investigated as an EC thin film. The application has been realized in smart windows and antireflection rear mirrors in cars. The film of tungsten oxide deposited on an electrode can be electrochemically reduced in the presence of an electrolyte according to the following electrochemical reaction :

Where M+ is H+ or Li+, x is the so-called ion insertion coefficient. Reduction of tungsten oxide involves entry of electrons into the tungsten oxide film from the electrode and of proton or lithium ion from other (electrolyte-facing) side. The reduced tungsten oxide is typically deep blue in colour and also absorbs broadly in the NIR region. The absorbance in the vis–NIR region depends on the degree of reduction or ion insertion coefficient and as well WO3 film morphology.

NIR-Absorbing Organic Materials

Several types of NIR-absorbing organic materials are reported in literature, including stacked naphthalimide anion radicals, fused phorphyrin arrays, doped polythiophenes and other related conducting polymers, sandwich-type lanthanide bisphthalocyanines, radical anions of conjugated diquinones (also called semiquinones), and mixed-valence binuclear metal complexes.

NIR-absorbing semiquinones

For a long time, quinones have been known as disperse dyes and also as electron acceptors. Although monoquinones and their corresponding radical anions have been thoroughly investigated, the radical anions of aromatic diquinones or semiquinones, have only recently received some attention, due to their unique NIR absorbing and semiconducting properties. e.g. pentacenediquinone is known for its NIR electrochromic. The study of symmetric d5/d6 mixed-valence binuclear ruthenium (II/III) species has contributed significantly to the understanding of bonding and electron transfer in and between metal complexes such as a classical example of the molecule-bridged Creutz–Taube ion. The binuclear mixed-valence ruthenium complexes are known to be EC and NIR absorbing.

Visual Stealth

Historically, stealth aircrafts like the F-117 and the B-2 Spirit were painted black and were supposed to fly only during the night time for effective camouflaging. However, the concept of day-time stealth has been researched by Lockheed Martin, such a plane would need to blend into the background sky and also carry antiradar and infrared stealth technology. Researchers at the University of Florida are in the process of developing an 'electro chromic polymer'. These thin sheets cover the aircraft's white skin and sense the hue, colour and brightness of the surrounding sky and ground. The image received is then projected onto the aircraft's opposite side. When charged to a certain voltage, these panels undergo colour change.

At the Tonopah test range airstrip in Nevada, another system was tested; as claimed by a technician working at the base, an F-15 equipped with this technology took off from the runway only to disappear from sight 3 Km away. Yet another similar "skin" is being tested at the top secret Groom Lake facility at Area 51 in Nevada. It is composed of an electro-magnetically conductive polyaniline-based radar absorbent composite material. The system also disposes photo-sensitive receptors all over the plane that scans the surrounding area; subsequently the data is interpreted by an onboard computer which outputs it much like a computer screen. Perhaps one day, in the very near future, one may fly in a completely invisible aircraft. B-2 Spirit bomber, Boeing's Bird of Prey and the F-35 Joint Strike Fighter represent the pinnacle of modern day advancements in this particular field of human endeavour.

Camouflage

Aircraft Camouflage

The design of camouflage for aircraft is complicated by the fact that the appearance of the aircraft's background varies widely, depending on the location of the observer (above or below) and the nature of the background. Many aircraft camouflage schemes of the past used counter shading, where a light colour was used underneath and darker colours above. Other camouflage schemes acknowledge that the aircraft will be twisting and turning while in combat, and the camouflage pattern is applied to the entire aircraft. Neutral and dull colours are preferred, and two or three shades selected, depending on the size of the aircraft.

Though air-to-air combat is often initialized outside of visual range, at medium distances camouflage can make an enemy pilot hesitate until certain of the attitude, distance and maneuver of the camouflaged aircraft.

The higher speeds of modern aircraft and the reliance on radar and missiles in air combat have reduced the value of visual camouflage, while increasing the value of electronic "stealth" measures. Modern paint is designed to absorb electromagnetic radiation used by radar, reducing the signature of the aircraft, and to limit

the emission of infrared light used by heat seeking missiles to detect their target. Further advances in aircraft camouflage are being investigated in the field of active camouflage.

Vehicle Camouflage

The purpose of vehicle and equipment camouflage differs from personal camouflage in that the primary threat is aerial reconnaissance. The goal is to disrupt the characteristic shape of the vehicle, reduce shine, and make the vehicle difficult to identify even if it is spotted. Methods to accomplish this include paint, nets, ghillie-type synthetic attachments, and natural materials. Paint is the least effective measure, but forms a basis for other techniques. Military vehicles often become so dirty that pattern-painted camouflage is not visible. Patterns are designed to make it more difficult to interpret shadows and shapes; matte colors are used to reduce shine, but a wet vehicle can still be very shiny, especially when viewed from above. Nets can be highly effective at defeating visual observation, but are useful mostly for stationary vehicles. They also take a lot of time to set up and take down. Nets are occasionally fixed in place around gun tubes or turrets, and if adequately attached can remain in place while the tank is moving. Nets are far less effective in defeating radar and thermal sensors. Synthetic attachments, analogous to ghillie-suit attachments, are sometimes used to break up shape. These are prone to loss as AFVs move across terrain, but can be effective. Natural materials, such as tree branches, bundles of leaves, piles of hay or small bits of urban wreckage can be highly effective when the vehicle is in a defensive position.

Ship Camouflage

Until the 20th century, naval weapons had a very short range, so camouflage was unimportant for ships or the men on board them. Paint schemes were selected on the basis of ease of maintenance or aesthetics, typically buff upperworks (with polished brass fittings) and white or black hulls. At the turn of the century the increasing range of naval engagements, as demonstrated by the Battle of Tsushima, prompted the introduction of the first camouflage, in the form of some solid shade of gray overall, in the hope that ships would fade into the mist.

Decoys

Decoys were extensively used during the Second World War. Rubber tanks were used to distract the enemy and know their position during that time. Nowadays decoy's are said to be used during missile launches like the ICBM's (Inter Continental Ballistic Missiles) a number of missiles will be launched to their orbits in which say only one or two will have the payload the others would be dummies to confuse the enemy any to increase the probability of counter missiles like the scud missiles.

ACOUSTICS

Acoustics means Sound and Acoustic signature is used to describe a combination of acoustic emissions of ships and submarines. Although Acoustic Signature are found in for land and arial units acoustic signature turns out to be the key method of dectection for Naval field rather than the other two.

SONAR (Sound Navigation and Ranging)

Sonar is very important part of anti submarine warfare. The sonar is a device for detecting and locating objects submerged in water by means of the sound waves they reflect or produce. It means that the active sonar wasn't used in fight against submarines. The first active sonar was constructed in 1918, in the Admiralty Experimental Station (UK). On the first testing the sonar found merged submarine on distance of a few hundred meters.

Hydro Acoustics

Sound is mechanical oscillating. Spreading of the sound is possible because of elastic connection between molecules. Molecules in liquids are closer one to another than in the air. Because of that the sound spreads faster in the water than in the air. Speed of the sound in the water is 4.4 times faster than in the air. Exact speed of the sound in the water is 1438 m/s, when temperature of the water is 8 degrees Celsius. Speed and direction of the sound wave spreading depend about temperature, salinity and depth of the water. The speed with which sound is transmitted is a characteristic of the material in question, proportional to the modulus or stiffness of the material and inversely proportional to its density. For example, the speed of sound in sea water can be calculated as follows :

Where, C = Speed of sound in sea water, approx. 57,735 in/sec, or 4,800 ft/sec, disregarding effects of temperature, salinity, and pressure. ~ 1450 m/s

K = Bulk modulus of sea water = 300,000 psi.
ρ = Density of sea water, based on a specific weight of 64 lbs./cu.ft. = 9 x 10-5 slugs/cu.in.

Sonar Properties

The first practical sonar units have been constructed between WW1 and WW2. The best working frequency was 20 kHz, pulse power was 50 W. Range was 1000 to 1500 meters (good working conditions) or 500 to 700 meters (bad working conditions). In WW2 there are two types of sonar, projection type and panoramic type.

(i) Projection sonar: beam 5 to 15 degrees, frequency 10 to 50 kHz, output pulse power 50 to 200 W, duration of signal 30 to 200 ms. Range was 800 to 4500 meters. In winter range was better than in summer. In WW2 average range of submarine detecting was 1350 meters (from a destroyer). Range of sonar depended about :

- power of output signal;
- working frequency – if frequency is lower range is bigger, but there is problem of direction; shape and size of ultra sound beam – narrow beam makes longer range and better directing than broad beam but with narrow bean it is harder keep contact with the submerged submarine and it is need more time to survey sector around the ship.
- Time of duration of output signal – for longer range survey the sonar needs longer duration of output signal.

(ii) Panoramic sonar : The sonar transmits its sound beam in all directions immediately. The sonar's receiver receives echo of the sound from all directions and shows possible contact on its screen, with direction and range of the contact.

Working frequency: 20 and 25.5 kHz, output power 200 to 800 W, duration of signal 6, 30 or 80 ms. Range was up to 3000 metros. The first successful panoramic sonar in the United States was QHB-1, in 1943. There was also sonar for detecting depth of submerged submarine. It was additional unit and it works together with standard sonar unit. Working frequency of that additional sonar was from 15 to 100 kHz. Depended about construction, there are: hull mounted sonar and towed sonar.

The Sonar Dectectors

Sonar detectors are simply devices that detect the presence of Sonar beams. They can be classified as :
Passive: - Passive sonar's listen without transmitting. They are usually military (although a few are scientific). Sonar in freshwater lakes is different in operation from sonar at sea. In salt water sonar operation is affected by temperature. Ocean temperature varies with depth, but at between 30 and 100 meters there is often an marked change, called the thermocline, dividing the warmer surface water from the cold, still waters that make up the rest of the ocean. Regarding sonar, a sound originating from one side of the thermocline tends to be reflected off the thermocline, unless it is very noisy. The thermocline is not present in shallower coastal waters. Pressure also effect sound propagation as convergence zones (CZ). Sound waves that are radiated down into the ocean bend back up to the surface in great arcs due to the effect of pressure on sound. Under the right conditions these waves will then reflect off the surface and repeat another arc. Each arc is called a CZ annulus. CZs are found every 33 nm, forming a annular pattern of concentric circles around the sound source. Sounds that can be detected for only a few miles in a direct line can therefore also be detected hundreds of miles away. The signal is naturally attenuated but modern sonar suites are very sensitive.

Active :- Active sonar creates a pulse of sound, often called a "ping", and then listens for reflections of the pulse. To measure the distance to an object, one measures the time from emission of a pulse to reception. To measure the bearing, one uses several hydrophones, and measures the relative arrival time to each in a process called beam-forming. The first active sonar technology was originally called ASDIC after the "Allied Submarine Detection Investigation Committee".

Sonar Stealth

As in case of all Stealth features is Sonar stealth the aim l to reduce sound from a Submarine or Ship thus remain undetected. There are many ways of reducing Acoustic Signature like reduction of vibration of the Submarine, reduce sounds due to cavitations etc.

Bathythermograph

A bathythermograph is an instrument for recording the temperature at various depths in the ocean. Area of detecting is from –2.2 to 32.2 degrees of Celsius. The bathythermograph may be fitted on a surface ship or on a submarine. During the measurements the ship's (or the submarines) speed can be up to 22 knots, normally up to 12 knots.

A bathythermograph consists of a thermal and a depth part. Results of the measurements are shown on a bathythermogram. When a submarine is submerged, she cannot use a bathythermograph. Instead of that, she has an apparatus for continuously measuring speed of a sound at all depths of the submarine. How a bathythermograph can be used to make sonar ineffective when we use a bathythermograph, we actually look for a thermo cline. A thermo cline is a layer of water where the temperature gradient is greater than that of the warmer layer above and the colder layer below. When the temperature gradient is greater, a sound wave rapidly bending towards the sea bottom. The sound wave goes to the sea bottom and "stay there". The sound wave is useless.

If a submarine is submerged at the layer of thermo cline or immediate below the layer, the submarine will not be "captured" from the wave, and she will stay undetected. Figure below shows situation when the submarine is submerged immediate below the layer of thermo cline, and the surface ship is fitted with the hull mounted sonar. There are usually two layers of a thermo cline in summer. One layer is on about 15 to 20 meters of depth, and another one is about 150 meters of depth. Depth of 15 to 20 meters is Fig10.1:- Properties of Bathythermograph Fig10.2:- Hull mounted Sonar important. During the summer, at afternoon, if weather conditions are good, a submarine could not be detected from standard (hull mounted) ship's sonar. In the same time, the depth is good for observing and torpedo launching. If the surface ship wishes to detect a submarine, the ship has to be fitted with towed sonar. In that case, the sonar must be submerged below the thermo cline. Picture shows situation when the submarine is submerged below the layer of thermo cline and the surface ship is fitted with towed sonar.

Sonar absorbers

Making an efficient, broadbanded sonar absorber presents a number of technical challenges. Most absorptive materials do not have the requisite impedance, and rigid materials are not lousy enough. In some cases, scattering can be used to enhance absorption, but this is not always practicable. Even more difficult are the effects of wavelength: absorbers designed for high frequencies are ineffective at low frequencies. Finally, whatever system is used, it must have good hydrostatic strength so that it may be used deep in the sea. The most promising development in this area is a new family of composite materials employing rigid syntactic foam in combination with a variety of fillers and ingredients. The addition of suitable additives to the syntactic system can provide a controlled amount of scattering or absorption. Reducing the elastic modulus of the resin binder to create more "rubbery" foam will introduce acoustic loss. A truly broadbanded sonar absorber with good hydrostatic strength can be made by dispersing suitably-sized elastomeric particles in a syntactic foam matrix. Using these principles, successful underwater sound absorbers have been made for a variety of military and civilian applications.

Syntactic foam is a lightweight, high strength composite material frequently used in the sea for floats and buoys, to support instruments, as submarine void filler, for encapsulating hydrophones, and so on.

LIDAR

LIDAR (Light Dectection and Ranging)

Lidars can be used in detecting stealth targets for its higher angular resolution, strong ability of anti-jamming, good concealment, and small size and light weight. Traditional radars use microwave and centimeter wave as carriers, while the lidar uses laser, which has much shorter wavelengths. The lidar uses amplitude, phase, frequency and polarization carries information and does not have essential difference with traditional radars. Several key technologies need to be taken into consideration in detecting stealth targets by lidars.

Lidar Properties

The target designation radar needs not only discovering stealth targets but also tracking and aiming so as to antagonize them. Extending radar wavelength is necessary. Laser radar can detect stealth targets effectively because it has short wavelength, high beam quality, strong directionality, high measuring accuracy and it has functions of target identifying, posture displaying and orbit recording. The normal operational wavelengths of laser radar include 0.5321m, 1.064 1m, 10.6 1m, etc. Target and background optical properties on different wavelengths and atmospheric effects of different wavelength need to be considered in lidar detection.

Target and Background Optical Properties

Targets act as a series of combined reflecting surfaces to lidars, and these reflection surfaces decide the

electric levels of echo signals. Both relative movement effects caused by targets movement and vector speed of targets can lead to the variation in reflected signals of lidars. Observed echo signals are called lidar characteristic signals which used to obtain target information. Reflection of several typical targets on 1.064 1m laser is shown in Table The main background noise sources are sun light, moon light, atmospheric dispersion and its own radiation, which cause background illegibility in the FOV (Field of View) of receiver. This can be widely used in aircraft photoelectric stealth.

Atmospheric Effects

There are three main atmospheric effects on lidar signal transmission. The first one is attenuation caused by atmosphere molecular absorption. H_2O, CO_2 and O_3 are the primary absorbing sources. Another kind of attenuation arises from Mie scattering by floating particles.

Atmospheric turbulence leads to the random changes of refractive index of atmosphere and causes wave-front aberration. Assuming that the original power of a lidar signal is ***P (λ)***, the power after transmission of *x* can be calculated by ***P (λÿ x) = P (λÿ 0) exp [-k (λ) x]***, where ***k (λ)*** denotes the attenuation coefficient which contains absorption and diffraction. It can be seen from formula that atmospheric attenuation depends strongly on operational wavelengths of lidars. So it is important to choose lasers with low atmospheric attenuation as the operational wavelength, such as 10.6 1m and 1.064 1m.

Figure shows the relationship between propagation range and atmospheric transmission on the operational wavelength of 1.064 1m. It shows atmospheric transmission under conditions of fine (with visibility of 25 km), clear (with visibility of 15 km), haze (with visibility of 5 km), mist (with visibility of 1 km), light fog (with visibility of 0.7 km) respectively.

Fig11.1:- Relationship between propagation range and atmospheric transmission under different weather conditions.

Laser Radar Cross Section (LRCS)

The LRCS of target is the symbol of laser scattering ability of target. It refers to the ratio of incident power in unit area to total scattering power when targets are isotropic scattering. This ratio has a dimension of area, and it denotes how much power stealth targets have got from the incident power. The LRCS is a complex function of targets' dynamic and static features, propagation media features and incident wave features. The LRCS can be calculated approximately as RCS in radar.

σ = 4 ð ρ A RÙR, where ***ρ*** denotes the reflectivity of target surface, ***AR*** denotes the projection area of target, ***ÙR*** denotes the solid angle of scattering beam. Reflecting signal of diffusive reflection targets will be scattered in a wide area, and the distribution of reflecting signals submit to the rule of Bidirectional Reflecting Distribution Function (BRDF).

The detected power of lidars can be derived from lidar operating range formula, where ***PR*** denotes the receiving power, ***PT*** denotes the transmitting power, ***R*** denotes the operating range, ***ÙT*** denotes the solid angle of transmitting beam, *AC* denotes the effective receiving area, and ò denotes the transmission of unidirectional transmission.

The relationship between the LRCS and operating range can be derived from formula and when *R* is the maximum operating range, ***σM*** is called the Critical LRCS, and the target is stealthy if inequality $\sigma < \sigma M$ is tenable. At this point, it is necessary to build a complex geometrical model and take account of the surface optical characters or material scattering characters to calculate LRCS of a stealth target with complicated shape. The graphic EM calculating model of a RF system can be used for reference of calculating the LRCS.

Lidar Stealth

As said early LIDAR can be considered as a special case of RADAR and hence the almost all stealth methods adopted for radars stated above are applicable for Lidars too like the Lidar jammer's etc.

Plasma Stealth

Plasma Stealth can be considered as a specific Stealth method employed for Ariel stealth. Couple of things to keep in mind: plasma is ionized gas particles. Therefore, plasma flow is a flow of ionized gas particles. Ion is an electrically charged particle or group of atoms. Plasma cloud is a quasineutral (total electrical charge is zero) collection of free charged particles. The vast majority of matter in the universe exists in plasma state. Near the Earth plasma can be found in the form of solar wind, magnetosphere and ionosphere. The main property of

plasma (for our purposes) is its frequency, which is equal to a square root of a ratio of 4 * Pi * square of ion charge * concentration of ions to the mass of ion :

SQRT ((4 * Pi * n * e ^ 2) / m), , where e is electron or ion charge, n is concentration of ions per volume of plasma and m is mass of ion.

There are several types of oscillations in plasma: low frequency (ion-sound waves), high frequency (oscillations of electrons relative to ions), spiral waves (in the presence of a magnetic field - "magnetosound"), and cross waves propagating along a magnetic field. A device for generating plasma is called *plasmatron*. This device generates the so-called low-temperature plasma. There are several types of oscillations in plasma: low frequency (ion-sound waves), high frequency (oscillations of electrons relative to ions), spiral waves (in the presence of a magnetic field - "magnetosound"), and cross waves propagating along a magnetic field. A device for generating plasma is called *plasmatron*. This device generates the so-called low-temperature plasma. This is truly unbelievable, but even this theoretically and technologically is perfectly possible. It is not known whether the plasma stealth system developed by the Russians employs a plasma laser or some other method for creating a plasma field. My personal opinion is that it has nothing to do with a plasma laser (which is a very large and very power-hungry device).

Plasma physics was given priority in Russia many years ago, which resulted in a number of breakthroughs in theory as well as practical applications of plasma. Perhaps one of the most interesting and promising applications of plasma is the so-called *ion thruster*, used to propel spacecraft. This technology was first developed in Russia (mainly by Keldysh Research Center) and recently successfully used on an American satellite.

Adaptive Water Curtain Technology (AWCT)

The Adaptive Water Curtain Technology (AWCT) is intended to deflect and scatter enemy radar waves thus reducing the ship's radar cross section (RCS). It consists of (highly conductive) sea water sprayed in a fashion that effectively creates an angled radar reflective curtain around the ship.

To reduce the ship's remaining RCS, the water curtain can be "modulated" such that the returns appear as "Sea Clutter." This could be done by determining the surrounding Sea State-either locally, or from satellite Sea State data, i.e., deriving the Sea Clutter Spectrum; and applying the appropriate coefficients to the modulating process for optimum mimicry. This approach is suggested as an "Add-On" to existing surface ships, an interim measure until the next generation DD(X) of stealthy surface ships has replaced this class. The Arleigh Burke class Destroyer—which has rudimentary stealth technology, is used as an example of a recipient ship for this technology. Although this class of ship has a reduced RCS over its predecessor, it can still benefit significantly from the proposed technology. This technology can reduce a surface ship's vulnerability to Radar cross-section (RCS), Infrared signature (IR), and Visual signature reduction.

FEATURES :

Reduced RCS. IR Signature Mitigation of Ship Stacks by the use of "Pre-Cooled" Water Curtain. Reduced Visual Signature (Camouflage). Possible EMP Protection System able to mimic Sea Clutter. Water streams can be "Modulated" for enhanced concealment.

Uses Fire Fighting Technology. Compensation for finite Water Stream boundaries (gaps), using Spray and Misting. System uses Feedback for accurate positioning of Water Stream "Landing zone." Able to (actively) Resist Wind Loading on Water Curtain. Can Selectively open Gaps in Water Curtain for Radar, IR, Communications, etc. Satellite (or RPV) for Interactive Sensing and Alignment for Stealth Optimization. System Cleaning by Periodic Flushing with brackish or clean water.

Fig13.1:- The Adaptive Water Curtain Technology (AWCT) is intended to deflect and scatter enemy radar waves thus reducing the ship's radar cross section (RCS). It consists of highly conductive sea water sprayed in a fashion that effectively creates an angled radar reflective curtain around the ship.

ADVANTAGES AND DISADVANTAGES OF STEALTH TECHNOLOGY

Advantages of Stealth Technology

1. A smaller number of stealth vehicles may replace fleet of conventional attacks vehicles with the same or increased combat efficiency. Possibly resulting in longer term savings in the military budget.

2. A Stealth vehicles strike capability may deter potential enemies from taking action and keep them in constant fear of strikes, since they can never know if the attack vehicles are already underway.

3. The production of a stealth combat vehicles design may force an opponent to pursue the same aim, possibly resulting in significant weakening of the economically inferior party.

4. Stationing stealth vehicles in a friendly country is a powerful diplomatic gesture as stealth vehicles incorporate high technology and military secrets.

5. Decreasing causality rates of the pilots and crew members.

Disadvantages of Stealth Technology

1. Stealth technology has its own disadvantages like other technologies. Stealth aircraft cannot fly as fast or is not manoeuvrable like conventional aircraft. The F-22 and the aircraft of its category proved this wrong up to an extent. Though the F-22 may be fast or manoeuvrable or fast, it can't go beyond Mach 2 and cannot make turns like the Su-37.

2. Another serious disadvantage with the stealth aircraft is the reduced amount of payload it can carry. As most of the payload is carried internally in a stealth aircraft to reduce the radar signature, weapons can only occupy a less amount of space internally. On the other hand a conventional aircraft can carry much more payload than any stealth aircraft of its class.

3. Whatever may be the disadvantage a stealth vehicles can have, the biggest of all disadvantages that it faces is its sheer cost. Stealth aircraft literally costs its weight in gold.

4. Fighters in service and in development for the USAF like the B-2 ($2 billion), F-117 ($70 million) and the F-22 ($100 million) are the costliest planes in the world. After the cold war, the number of B-2 bombers was reduced sharply because of its staggering price tag and maintenance charges.

5. The B-2 Spirit carries a large bomb load, but it has relatively slow speed, resulting in 18 to 24 hour long missions when it flies half way around the globe to attack overseas targets. Therefore advance planning and receiving intelligence in a timely manner is of paramount importance.

6. Stealth aircraft are vulnerable to detection immediately before, during and after using their weaponry. since reduced RCS bombs and cruise Missiles are yet not available; all armament must be carried internally to avoid increasing the radar cross section. As soon as the bomb bay doors opened, the planes RCS will be multiplied.

7. Another problem with incorporating "stealth" technology into an aircraft is a wing shape that does not provide the optimum amount of lift. The resulting increase in drag reduces flight performance. "Stealth" shapes, such as the "faceting" found on Lockheed's F-117 "stealth" fighter, also tend to be aerodynamically destabilizing. This is brought under control only through the use of highly sophisticated computers that serve to electronically balance the aircraft in flight through its autopilot and control system. All of these modifications, however, hurt the plane's performance, adding weight, affecting aerodynamics, and altering the structure of the aircraft.

8. The advantages of stealth technology must always be weighed against its disadvantages impossible.

CONCLUSION

The Detection and Stealth Technology has improved significantly more advanced in the last fifty years or so. This trend is likely to continue as these two oppose each other. Till date stealth aircraft have been used in several low and moderate intensity conflicts, including operation Desert Storm. Operation Allied Force and the 2003 invasion of Iraq .In each case they were employed to strike high value targets which were either out of range of conventional aircraft or which were too heavily defended for conventional aircraft to strike without a high risk of loss. In addition, because The stealth aircraft aren't going to be dodging surface to air missiles and anti-aircraft artillery over the target they can aim more carefully and thus are more likely to hit the high value targets early in the campaign (or even for it). Before other aircraft had the opportunity to degrade the opposing air defense. However, given the increasing prevalence of excellent Russion-bilt Surface –to-air missile (SAM) system on the open market, stealth aircraft are likely to be very important in a high intensity conflict in order to gain and maintain air supremacy. Stealth

technology in future would be required for clearing the way for deeper strikes, which conventional aircraft would find very difficult .For example ,China license-builds a wide range of SAM systems in quantity and would be able to heavily defend important strategic and tactical targets in the event of some kind of conflict .Even if antiradiation weapons are used in an attempt to destroy the SAM radars of such systems, these SAMs are capable of shooting down weapons fired against them. The surprise of a stealth attack may become the only reasonable way of making a safe corridor for conventional bombers. It would then be possible for the less-stealth force with superior weaponry to suppress the remaining systems and gain air superiority. The development and the deployment of the Visby's- the first commissioned Stealth ships has raised new threats in the maritime boundaries. The sudden appearance of sea clutters on the radar at a region may be these ships. The plasma stealth technology raises new hopes of engineering brilliance. As plasma is said to absorb all electromagnetic radiation the development of a counter stealth technology to such a mechanism will be a strenuous task. Well to conclude the current scenario appears something similar to the cold war both sides are accumulating weapons to counter each other and each side can be termed as "Stealth Technology" and the other as "Anti-Stealth Technology". It's an arm race except it isn't between specific countries. "It's a fight between Technologies".

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Press release

Solidaridad, Stahl & PUM launch five-year tannery project for a cleaner Ganges river

Waalwijk, 14 November 2017 – On November 13, Solidaridad, Stahl and PUM Netherlands senior experts and a number of Indian partners officially launched a public-private partnership to clean up the Ganges. The project endeavors to make the Kanpur Leather Cluster more sustainable by implementing new working methods and state-of-the-art technologies with a lower environmental impact. This five-year project aims to address several challenges related to overall water use and pollution from the Kanpur leather cluster,which is partly responsible for pollution loads in the Ganges.

The overall objective of the five-year project is to reduce the effluent water discharged by at least 40% and to introduce alternative technologies and processes at tanneries with a reduced environmental impact. Solidaridad, Stahl and PUM are working together with the local partners Uttar Pradesh Leather Industry Association, Small Tanners Association, Central Leather Research Institute and Ganga Pollution Control Unit. The latter is part of the wider 'Clean Ganga' initiative launched by the Indian government several years ago.

Together these partners will introduce environmentally cautious production methods and train tannery staff on best practices. A Stahl Center of Excellence will be established to demonstrate more sustainable technologies. In addition, there are activities for downstream communities about efficient water use for irrigation and livestock farming. "Solidaridad sees cooperation with tanneries and governments as the key to a cleaner Ganges", says Gert van der Bijl, International Programme Manager Livestock & Leather at Solidaridad. "Together we work on sustainable work practices for these tanneries. Solidaridad will introduce new technologies, business processes and trainings at all levels to diminish water use and pollution. Improving working conditions is an important focus."

With this project, Stahl reaffirms its commitment to achieving a more sustainable leather industry via transparency. "At Stahl we believe in actively promoting safe usage of chemicals around the world,"says Michael Costello, Director Sustainability at Stahl. "We are well aware of the complex issues in the Kanpur leather cluster where some 400 tanneries discharge 50 million liters of waste water each day. We also understand that we alone cannot change the situation, so we have joined forces

with industry partners and local authorities to contribute to the clean-up already underway of this iconic and sacred river," he adds.

"There is a lot of talk about aid & trade these days, but bringing tangible benefits to working class families while sparing the environment is hard work," PUM CEO Johan van de Gronden says. "We are proud to work with governments, the industry, NGO's and the local communities to help build a leather supply chain that is as vibrant as it is clean."

The project is supported by The Sustainable Water Fund programme (FDW), a Public-Private-Partnership facility of the Dutch Ministry of Foreign Affairs. Solidaridad is the overall project coordinator and consortium leader, Stahl is the main private contributor and PUM provides technical assistance and training support from senior experts.

About the project partners:

Stahl

Stahl is leading in process chemicals for leather products, performance coatings and polymers. We offer a wide range of solutions to the automotive, apparel & accessories, architectural & interior design, leisure & lifestyle industry and for industrial applications. With more than 2,100 employees in 24 countries at 13 manufacturing sites and 38 laboratories, Stahl is expected to realize an annual turnover of over 870 million euro. With its innovation power, expertise and range of technical solutions, Stahl is able to deliver best in class solutions and services to respond even better to client needs and secure a more sustainable future.

Solidaridad network

Solidaridad is an international solution-oriented civil society organization working through nine regional expertise centers on transforming markets to make them more inclusive and sustainable. We bring together supply chain players and engage them with innovative solutions to improve production, ensuring the transition to a sustainable and inclusive economy that maximizes the benefit for all.

PUM Netherlands senior experts

PUM Netherlands senior experts offers knowledge and expertise in 50 sectors of the economy. Our senior experts share their knowledge on a voluntary base with entrepreneurs in more than 30 developing countries and emerging markets worldwide in order to create vibrant businesses, better lives.

LEATHER EXPORTS TO RISE 10% BY 2019 : MINISTER

New Delhi : Leather exports and production are expected to increase by 10 per cent by 2019, Minister of State for Commerce and Industry C R Chaudhary said on Monday. India's leather exports currently stands at USD 5.66 billion.

"We are expecting that by 2019, leather exports and production would increase by 10 per cent," he told reporters here.

The minister also said that the government is taking steps to improve business environment for the sector as part of the exercise to push growth. Chaudhary further said that all Footwear Design and Development Institutes (FDDIs) would become institutes of national importance from on Monday.

The FDDI Act, which was approved by Parliament, will be implemented from Monday, he added. FDDIs will be able to give degrees, diplomas and certificates and they would also formulate their course and curriculum, he added.

The approval of the FDDI Act by Parliament in July had ended the uncertainty among the students who were not sure whether they would get degree from the institute.

The controversy with regard to the institute dates back to 2015, when the UGC, in September 2014, raised questions against the MoU between FDDI and Mewar University for grant of degree to students for the years 2012, 2013 and 2014.

In 2016, students of FDDI, Noida went on protest demanding degrees instead of diplomas. The FDDI has 12 campuses of which eight are functional. When asked whether ban on cow slaughter and increased cow vigilantism has impacted raw material availability and exports of leather, the minister said it is not so.

GOVT. LETS FOOTWEAR INSTITUTE AWARD DIPLOMAS, DEGREES

With the grant of 'Institute of National Importance' status, the Footwear Design and Development Institute (FDDI) can now award degrees to its students, the government announced on Monday.

"The government commitment to resolve the degree issue has culminated in the grant of the said status to FDDI. The FDDI now has the autonomy to design its courses as per the requirement of industry and award its own degree to the students," Minister of State for Commerce C. R. Chaudhary told reporters here.

"With this, the government has ensured upgradation of FDDI to a position of eminence so as to enable the institute to effectively serve the sector," he added. The provisions of the FDDI Act, 2017, passed by Parliament in July, came into force with their notification on Monday.

"The FDDI can now independently develop and conduct courses leading to graduate and postgraduate degrees, doctoral and post-doctoral courses and research in the areas of footwear and leather products design and development and allied fields," he added.

The institute is currently imparting skill-based graduate and postgraduate courses in footwear, leather goods, retail and management to around 2,500 students in eight campuses across India.

The FDDI will now be able to enroll around 2,500 more students in the coming academic session across 12 campuses, of which four new ones at Patna, Hyderabad, Ankleshwar and Banur will become functional from the next session, Chaudhary said.

LEATHER AND LEATHER FOOTWEAR EXPORT FACING MASSIVE CHALLENGERS

Leather and leather footwear export has been facing significant hurdles due to challenging internal as well as external environment. Demand has been impacted due to the weak consumer sentiment in the European Union (EU – the biggest destination of India's footwear exports) and a significant drop in the value of the British Pound (GBP) following the vote on referendum to exit the European Union, according to a report.

The sector is also facing headwinds due to appreciation in the value of the rupee against major currencies and recent regulatory restrictions placed on slaughter of animals and on leather tanneries, impacting raw material availability. Because of these factors, the export figures show a decline for two consecutive years, by ~9% in FY 2016 and ~5% in FY 2017. ICRA expects similar trends to continue in the near term which should impact the earnings of export focused leather footwear players.

(Times of India)

ASIA'S LARGEST CATTLE FAIR BEGINS IN BIHAR

Patna, Nov 2 (IANS) Sonepur cattle fair, considered as Asia's largest such, kicked-off in Bihar on Thursday. Bihar Deputy Chief Minister Sushil Kumar Modi inaugurated the fair, terming it the "pride of India and not only of Bihar".

"The government will develop this on the lines of a world fair to attract more and more domestic and foreign tourists in the coming years." The cattle fair is held annually, beginning on Kartick Poornima, at Sonepur in Saran district, about 30 KM from Patna. It will continue for a month.

The fair ground is an extensive 500 acres of land near the confluence of the Ganga and Gandak rivers. Cows, buffaloes, oxen, goats, horses, donkeys, monkeys, rabbits, bears, cats and guinea pigs are traded at the fair.

(Bihar Times – 11/10/2017)

INDIGENOUS VEGETABLE TANSTUFFS VIS-A-VIS IMPORT SUBSTITUTION

C. KOTESWARA RAO AND Y. NAYUDAMMA

(Central Leather Research Institute, Madras)

(A variety of tannin extract blends, using indigenous vegetable transtuffs, like cashew testa, babul bark and myrobalan have been produced in pilot scale. The blends so made are standardized, keeping in view their ultimate use as substitutes for imported tanning agents like wattle extract.

In this paper the authors have also brought out the salient features of these products as against the imported tanning agents and their use in the tanning industry).

1. Need for Tanstuffs

1.1 The Indian leather industry engaged in the production of sole leather, industrial leathers and E.I. leathers that are mostly exported, depends on indigenous tanstuffs like avaram bark, babul bark, myrobalan fruits and imported tanning agents like wattle bark and wattle extract. During 1964-65, the import of wattle extract was found to be around 26,000 tonnes valued at Rs. 2.7 crores. There is, however, an indigenous production of wattle bark, to an extent of about 10,000 tonnes per year, from the plantations raised by the Government of Madras in an area of 29,000 acres in both the Kodai and Nilgiri hills. This local production of bark is yet to be utilized in commercial production of wattle extract.

1.2 Although our forests in the country, particularly in Madhya Pradesh, Maharashtra, Andhra Pradesh and Madras State are adorned with a variety of other tanstuffs, occurring in large areas in large quantities, they have not been harnessed or pooled to proper utilization as substitutes for wattle.

1.3 It is estimated that the leather industry in the country requires about 70,000 tonnes of tannin extracts, annually. It will be stupendous task to meet this ever-growing demand for tannin extracts. But the imports have also been restrained and there is urgent necessity for conserving of foreign exchange and also achieving self-reliance in the industry. These challenging problems call in for concerted efforts by the research organization in order to produce tannin extracts, using indigenous tanning materials, which may compare favourably, if not fully, with the imported tanning agents.

In the course of such investigations, a number of indigenous tanstuffs have been examined for their utility in tannin extract-manufacture.

2. Present State of Knowledge

2.1 Indigenous tanstuffs like Karada bark, Goran bark, Kodukkapali bark, Hopea bark [2], [3] and cashew testa [4] have been found to be suitable substitutes for wattle bark and wattle extract.

2.2 Other tanstuffs like white valem bark, dhawada bark, sal bark, saja bark, etc., which are available in large quantities have been suggested as substitutes for avaram bark and babul bark and also as suitable tanning agents in blend form for the production of variety of leathers.[3] A number of laboratory scale experiments to produce blend extracts, using babul bark, avarm bark and Konnam bark with myrobalan have also been carried out [1]. These blends have been tested for their efficiency in tanning processes and found to yield leathers of good quality.

2.2.1 Also, myrobalan tannins have been suitably modified with certain chemical treatments and are being tested for their tanning potential as both self-tanning agent and as substitute for wattle. It is also reported that some of the chemical firms like BAYER and BASF in Germany are attempting to produce modified myrobalan extracts, which might work as substitutes for wattle extract. However, the results obtained so far have not been utilized to produce tannin extracts on a commercial scale.

2.3 Based on the results obtained so far, some of the promising indigenous tanstuffs have been taken up to produce tannin extract blends on a semi-commercial scale.

3. Preparation of Tannin Extract Blends

3.1 The tanning materials taken up in the present study are indicated in Table 1.

TABLE 1

No.	*Tanning material*	*Tans per cent*	*N. Tans per cent*	*Moisture per cent*
1	Wattle bark	35.6	10.5	10.5
2	Babul bark	12.5	10.5	10.0
3	Cashew testa	25.4	11.0	11.0
4	Myrobalan nuts	25.5	11.5	12.0

3.2 The first three tanstuffs in the above table belong to catechol type of tannins while the fourth one is a hydrolysable type of tannin. In the usual tanning practices, a blend of catechol tannin like wattle and myrobalan, a hydrolysable tan-

nin are used. Wattle bark that is produced locally is almost similar to the imported bark in its tannin content, etc.

3.2.1 It can also be noted from the table that wattle bark contains the highest amount of tannin and less of non-tannins.

3.2.2 Cashew testa is yet another indigenous production, its tannins being akin to wattle tannins. Cashew testa was first noticed to contain tannins in the Industrial Testing and Research Laboratory, Trivandrum. The availability of Cashew testa is estimated around 3,000 tonnes per year in and around Quilon (Kerala State), where about 90 per cent of Cashew processing industry is concentrated. Myrobalan fruits, which are a monopolistic produce of Indian forests are estimated in quantities of about one lakh tonnes per year. Babul bark, whose actual production figures are not available, is estimated to be available in abundance from regions like Punjab and Rajasthan.

3.3 Now the problem is as how to produce tannin extracts from these indigenous materials, which may conform to certain specifications as met with by wattle extract. There are two ways of doing it, namely, making straight tannin extract from the specific tanstuff or by blending the catechol type of tannin with myrobalans. These blends may have added advantage such as working as a tailor-made product, which helps to avoid the intermediate stage of myrobing process in the tannage. Blend extracts are in vogue in continental countries for a long time, while no efforts were made before in our country.

3.3.1 Hence, tannin extracts in straight form Cashew testa and babul were produced in our Institute. As the total solubles present in babul bark are very low as compared to wattle tannin, apart from the difficulty in penetration of babul tannin extract, the production of straight extract was found to be uneconomical and unsuitable; where as the tannin extract from Cashew testa was found to be quite suitable as substitute for wattle, particularly in the production of sole leather. However, the straight extract suffered from a disadvantage that it is darker in colour, as compared to wattle extract. But cashew extracts of equal grade as wattle extract could be made by bleaching process.

3.4 Yet, another course of investigation, as pointed out earlier is the production of blends, using wattle or babul or cashew testa with myrobalans. A number of blend extracts have been produced, by a judicial blending of the above materials. Typical compositions of the tannin extracts both in straight and blend form in comparison to wattle extract are given in Table 2.

3.5 It can be observed from Table 2 that wattle extract has a lower acid and salt content and a higher tannin content. Cashew extract (CH) is similar to wattle tannin extract, excepting a lower percentage of tannin content. Other products namely the blends, made from cashew testa-myrobalan (CHMI), wattle-myrobalan (WM) and babul-myrobalan (BMI) show a higher percentage of acid and salts and

TABLE II

No.	Tannin extract (spray dried)	Moisture	Tannin	Non-tannin	Insolubles	Colour Y/R	m.eq.per 100g total solids: Acids	Salts
1	Wattle extract (Imported-special)	3.5	72.0	23.5	1.0	2.2/1.3	10.2	50.1
2	Cashew extract (CH-unbleached)	4.8	58.2	35.5	1.5	12.1/4.2	25.5	60.8
3	CHMI (blend)	4.39	57.68	35.82	2.11	3/3	95.8	73.0
4	W. M (blend)	4.0	63.29	28.27	4.44	6/5	67.4	65.85
5	BMI (blend)	5.26	54.86	36.36	3.52	9/4	80.9	93.9

a lower content of tannins. The data evidently indicate that blend extracts are not equal in all respects as compared to straight wattle extract. But, however, the tanning properties such as penetration, and yielding firm and strong leathers are ensured even with these blend extracts.

4. Field Trials

4.1 Considerable quantities of blend extract CHMI, WM and BMI are produced in our Institute on a semi-commercial basis and tested for their efficacy and efficiency in tanning process for sole leather, E.I. leathers, etc. The products have shown satisfactory results in comparison to similar use of wattle extract. After having satisfied with the products in our own tannery, the products were then released through a private firm to a number of tanners, spread all over the country. Extract CHMI has particularly commanded greater demand from the consumers. Similarly extracts WM and BMI were also released and found to be suitable substitutes for wattle extract. The test reports received from various tanners corroborate the findings of the Institute.

4.2 As expected and usual in popularising new products, there have been considerable difficulties in the earlier stages of marketing. These initial problems have been surmounted by assuring the tanners the returns and also by advising him to use the blend extracts in bag per bag ratio along with wattle extract. Now as more tanners show demand for these products, the consensus is that blend extracts could find a favourable position in the tanning industry in the near future. Even the blend of wattle (Indian) and myrobalan would prove a great boon to the prospective manufacturers of tannin extract from the Indian Wattle, as it would

aid in increasing the capacity of production and better utilization of both wattle bark, whose supplies are limited and myrobalans, whose supplies are enormous but which have received little reception by the tanning industry. Similarly, production of other blend extracts like CHMI, BMI, etc, would also pave the way for greater appreciation of Indian products and gradually help reduce import of wattle extract.

4.3 Technical know-how on the preparation of these blend extracts is ready with the Institute and some tannin extract manufacturers have already come forward to translate these results into commercial production and exploitation. The price of blend extracts will be much lower than the cost of imported extracts.

4.4 There are yet many other tanstuffs like sal bark, saja bark, goran bark etc, which offer wider scope for blending with myrobalan and coverting them into finished tannin extracts. Investigations are under progress on these indigenous materials.

5. Acknowledgement

5.1 The authors wish to thank the Technical Services Units of the Institute for conducting the analysis of the tanstuffs and tannin extracts.

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Dr. K. V. Raghavan

[1st October, 1943 – 12th October, 2017]

Dr. K. V. Raghavan was a fellow of the National Academy of Engineering, Indian Institute of Chemical Engineers (IIChE) and A. P. Akademi of Sciences (APSA) and a Distinguished Fellowof University of Grants Commission (UGC). He did his B. Tech from Osmania University in 1964; M. S. and Ph. D. from Indian Institute of Technology (IIT), Madras.

He joined CSIR service in 1964 and worked in three national laboratories. He was appointed as the Director of Central Leather Research Institute (CLRI), Chennai in 1994. He took over the Directorship of Indian Institute of Chemical Technology, Hyderabad in 1996. On successful completion of this tenure, he was appointed as the Chairman of Recruitment and Assessment Centre of DRDO, Ministry of Defence, Government of India in May, 2004.

He published more than 120 papers, filed 45 patents and edited 3 books. His applied research efforts, covering a time span of over four decades, contributed to the successful development of more than 25 chemical processes with high industrial impact in bulk organics, specialities, oil field chemicals and fluoroorganics. He made significant contribution to the technological upgradation of leather, agrochemical and drugs/pharma sectors.

Dr. Raghavan was the recipient of the Hindustan Lever Award of the Most Outstanding Chemical Engineer, NRDC Invention Promotion Award, Pilot Officer D V Ranga Reddy Gold Medal, J N Sinha Roy Memorial and ChemTech Foundation Awards, Nayudamma Gold Medal of A. P. Akademi of Sciences (2010) and Institution of Engineers Award of Outstanding Chemical Engineer (2010). He was a Life Member of Indian Leather Technologists' Association.

12%, 18% GST rates to be merged; 28% on luxury, sin goods, says Arun Jaitley

inance Minister Arun Jaitley today hinted at merging 12 and 18 per cent tax rates under GST once revenue collections pick up and said the top 28 per cent slab would be for a "very thin" list of luxury and sin goods. The Goods and Services Tax (GST), rolled out on July 1, currently has four tax slabs of 5, 12 18 and 28 per cent. There is also a zero per cent tax on certain essential daily use commodities. Speaking at the HT Leadership Summit, Jaitley said the new indirect tax regime started with multiple rates in order to keep the tax incidence around the same level that existed pre-GST. Stating that the country would eventually move to a two- tier GST, he said that how fast it could be done would depend on the revenue position of the government. "We have thinned down the 28 per cent bracket, we can thin down more and it can be at some stage confined to luxury and demerit goods," jaitley said adding that as GST collections improve, the govt would see if there is a scope for merging 12 and 18 per cent slabs.

He said the merging of 12 and 18 per cent slab would mean some items in 12 per cent bracket will be sent to 5 per cent, resulting in two rates of 5 per cent and another 'X' per cent. Also, there will be a "very thin" list of items in the highest tax slab of 28 per cent. "Eventually, that will be the direction. But how fast you can do it will depend on how the revenues pick up," he said. He said a single rate GST is possible only in countries which have similarly placed population and in a highly differentiated society like India it would have been inflationary. "Can you have a GST in India where a Mercedes car and a hawai chappal is taxed at the same rate? That's socially not acceptable," Jaitley said.

He said before the implementation of GST on July 1, most of the goods, including geometry box, rubber bands, copy books, were being taxed at 31 per cent. "So, temporary we parked them at 28 per cent. I had thought it would take a lot more time to rationalize it but most of them we have brought it down to 18 and 12 per cent now. So, we have started the rationalization ahead of schedule," he said. Jaitley said there was a need to reduce the compliance burden on small and medium enterprises. Under the GST regime, 95 per cent of tax comes from 4 lakh assessees, who pay their taxes on time. "The noise comes from several other areas and I think there is a need for the millions (of businesses) who pay the balance 5 per cent tax to actually reduce the compliance burden on them. And I do consider it is a legitimate noise. Therefore, reducing that compliance burden is something that is called for," he said.

(Financial Express - 30/11/2017)

It's still early days for predicting upward trend, says Chidambaram, but welcomes increased growth rate

Former Union Finance Minister P. Chidamabaram on Thursday welcomed the marginal improvement in the growth numbers, but stated that it is still early days for predicting an upward trend.

"I am happy that the July-September quarter has registered a growth rate of 6.3%. This is a pause in the declining trend of the last five quarters. But we cannot say now whether this will mark an upward trend in the growth rate," he said.

He said a more accurate picture on the direction of the economy could be gauged only after following the growth figures for the next few quarters. "We should wait for the growth rates over the next 3-4 quarters before we can reach a definite conclusion," he said.

The latest growth numbers may prove to be a big relief to the ruling BJP in the middle of the Gujarat elections. Ever since growth figures went below 6% in the previous quarter (figures were announced in August), the Opposition had mounted an offensive against the Modi government.

The Congress had argued that the less than 6% growth numbers reflected slowdown and job losses caused by the note ban.

And the party had claimed that former Prime Minister Manmohan Singh's prediction of a 2% drop owing to demonetization.

But the BJP had always argued that the impact of the note ban was temporary and would even out over two-three quarters.

(The Hindu - 30/11/2017)

Shipping, airline companies add to GST woes: Exporters

Exporters have informed the finance ministry that goods and services tax refunds are getting delayed due to airline and shipping companies not submitting proof of export to customs and mismatches of invoice numbers in shipping bills and GST return forms.

India's exports dipped for the first time in 15 months in October, falling 1.1% to $23.1billion and are expected to fall further in November as exporters turn away clients and new orders while they get to grips with the new tax regime, which was rolled out on July 1. Last month's trade deficit widened the most in three years to $14 billion.

The Federation of Indian Export Organisations (FIEO) also said that despite the customs department allowing manual filing of input tax credit refund claims more than 10 days ago, the required application form (RFD-01A) is not available on the GST portal.

"Only a fraction of the IGST (integrated GST) claims of July has been paid. The process has not even started for input tax credit," FIEO director general Ajay Sahai said.

Industry estimates that 85% of refunds are on account of input tax credit and 15% from IGST. The delayed refunds are pegged at as much as Rs 50,000 crore.

Exporters also said there are no clear instructions on whether to mention the GST invoice number in the shipping bill as opposed to the commercial invoice number as has been done traditionally. They also complain about being "absolutely in dark" about the status of their pending claims and want to be able to view the status of such payments.

Most of India's traditional exports like textiles, leather and gems and jewellery fell in October even as global demand is stable. The country lost market share to Sri Lanka, Vietnam and Bangladesh in textiles and to China in footwear, according to Sahai.

"Exporters have informed that jurisdictional authorities are unaware of the procedure for refund. The details of documents required for refund are also not prescribed," said the FIEO letter. Exporters have also expressed their reservation against a manual system that adds to transaction time and costs.

(Economic Times - 28/11/2017)

India's export competitiveness at a decade low: Crisil

India's competitiveness in the labour intensive export sectors has been on a declining path in the last decade and needs significant structural reforms that need to be addressed, rating agency CrisilBSE -1.95 % said in a report.

Crisil analyzed the competitiveness of the labour intensive export sectors namely, gems & jewellery, leather & leather products and readymade garments which showed that these are become less competitive over the last decade.

"It is disquieting that India's export growth is decelerating at a time when the global environment is becoming more conducive for trade. The reason is not currency strength, but weakening competitiveness. This needs to be reversed if India has to see sustainable, employment-generating exports growth," Crisil said.

India's exports have fallen despite a favourable global trade environment. The International Monetary Fund (IMF) expects global growth to rise to 3.6% in 2017 from 3.2% in 2016.

"Global merchandise trade is expected to grow stronger at 4.2%, boosting trade intensity of growth for the first time in six years. Yet, India's exports have not been able to take as much advantage of the stronger trade growth unlike many of its Asian peers like Vietnam, South Korea and Indonesia," Crisil said.

While India's export growth is 9.5% in this fiscal so far, for Vietnam, South Korea, and Indonesia it was way higher at 23.8%, 18.4% and 17.8%, respectively.

(Economic Times – 27/11/2017)

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