ASM INTERNATIONAL

Bangalore Chapter – News Letter

Issue 5 : May 2021

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Chairman's Message

Much as we thought that Covid had spared our country of a heavy toll, and were settling into our past routines, the second wave returned with ferocity and has scarred most of our families and many acquaintances. Bengaluru Chapter lost one of its members Mr. Aji Kumar of Aswathy Heat Tech, a prominent manufacturer of Sealed Quench and other Furnaces based out of Bengaluru. As some predict the World will no longer be the same again, and some of the adaptations of the Covid Era are here to stay. Not all the changes are undesirable though, proving the adage "***Adversity is the Best University***". The ability to meet, interact and Engage Virtually without Physically meeting is welcome because of the savings it offers in time and reduced commute etc.

Bengaluru Chapter has not been able to conduct any workshops for some time now but the frequency and intensity of Virtual Technical Talks has been enhanced, thanks to the efforts of our members in the scientific community. We have also been engaging with three prominent Engineering Colleges to enroll the participation of students & Staff from Academia and have recently signed an MOU with SJBIT, Bengaluru.

We Pray for the Safety and Well Being of all the members of our community.

Mr. Rahul Masurekar

ASM INTERNATIONAL

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About ASM International

ASM International formerly known as the American Society for Metals was established in 1913 as a professional body of heat treaters. It has since evolved as an international professional body of material scientists, engineers, R&D professionals and academicians with the motto of collecting &disseminating knowledge on Materials and Processes. The worldwide network of more than 38,000 individuals is led by members, guided by members' needs and fueled by members' participation.

About ASM Bangalore Chapter

ASM Bangalore chapter is actively involved in dissemination of materials centric knowledge among working professionals, researches and academicians. ASM Bangalore chapter began its activities in the year 2006. Since then it has dedicated itself in spreading information based on materials among various stakeholders. Bangalore is a strategic center for several major automotive, aerospace, defense & R&D institutes and thousands of engineering professionals and it is imperative to educate & connecting the community in the field of Metals & Material science Technology. Under the able leadership of present chairman Mr. Rahul Masurekar – a well-known Industrialist and capable office bearers, ASM Bangalore chapter is gaining wide popularity by activity involving and supporting the technological up-gradation of Engineering community.

The Prime Objectives of ASM Bangalore Chapter:

1. To disseminate materials centric information among professionals by organizing seminars, lectures, One/two days' workshops
2. To bring together Scientists, Intellectuals and Professionals working in the field of materials science to exchange ideas/knowledge/information.
3. To encourage and support student chapters among various Engineering colleges in the state of Karnataka and enlighten them, the importance of materials properties, selection and its application.
4. To Promote consultancy services by ASM members to solve industry problems in the area of materials.
5. To recognize and award ASM members for their contributions to field of materials science.

ASM Bangalore chapter has members with rich expertise and professional experience with deep insight to practical applications in the field of materials science & engineering. ASM Bangalore chapter offers consultancy in the broad areas of Material selection &Characterization, foundry practices, mechanical testing, forging, heat-treatment, failure analysis, Corrosion control, Nondestructive Evaluation (NDE), process simulation to name a few.

ASM Membership

A membership in ASM gives you every imaginable edge you seek in your career.
VISIT - **http://www.asmblrchapter.com/membership.php** - for Benefits and Forms
Or Call Membership Chair – Mr. Krishnadas Nair – 8879233440
Or write ASM Bangalore Chapter **asmblr2015@gmail.com**

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Featured Articles:

FLASH CARBIDE ®

"Latest Process for Hard Chrome Replacement for Industrial Components"

- By Sri P. T. Bindagi

The author P.T. Bindagi is Technical Director at Spraymet Surface Technologies Pvt. Ltd. headquartered in Bangalore.

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Although replacing hard chrome plating with alternate processes is not new to industry, it has gained momentum in recent years due to the tightening of federal and state environmental standards for the exposure to hexavalent chromium also known Chrome 6.

Besides the environmental concerns behind hard chrome plating, performance benefits are driving the move to alternate processes even faster. Manufacturers continue to look for new technologies to improve component life and performance in the face of rising fuel prices, increasing stringent government regulations and the need to continuously improve total cost of operation of their machines.

For a marginal higher initial cost, FLASH CARBIDE® coatings offer longer wear life, improved corrosion protection, and higher fatigue lives when compared to hard chrome plate. While comparing final cost, disposal costs for chrome plating are significant. The left-over plating chemicals must be disposed of as hazardous waste. Trucking and disposal are large costs which must be taken into account.

Economics

While chrome plating can look like a less expensive option because of the lower initial cost, ROI calculations demonstrate the overall lower cost of using FLASH CARBIDE®. Flash carbide coatings have proven to be more wear and corrosion resistant than hard chrome. Field and lab data confirm tungsten carbide, chrome carbide, and chrome oxide coatings can last 3 to 5 times longer than hard

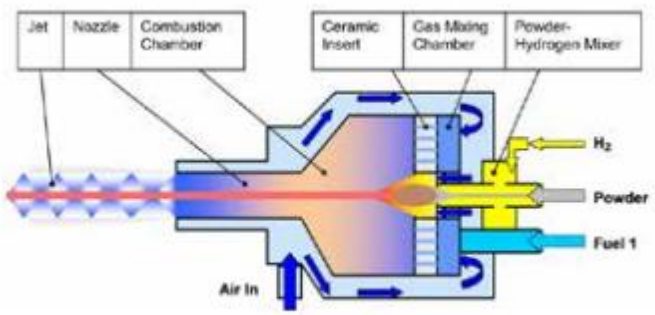
chrome plating. So whenever calculating the return on investment to compare the cost of chrome plating verses thermal spray coating downtime it is important to include the cost of downtime as part of the equation. Reducing total cost of operation is the goal.

Process: FLASH CARBIDE® Basics :

Flash carbide is a High velocity Air fuel (HVAF) Tungsten carbide coating applied using nano powder to replace chrome. HVOF was invented by Kermetico US A in 2016 now commercially available at Spraymet Surface Technologies Pvt ltd Bangalore. It involves using a high velocity flame spray device pictured adjacent, into which the nano carbide powder is introduced. The sprayed powder particles impact the work piece and form splats which are built up to make the coating in layers. The bond between the coating and the work piece is a mechanical bond with bond strengths of greater than 12,000 psi (test as per ASTM C633). Flash carbide coatings have porosities of less than 0. 6% and no micro cracks etc and this is the reason for their excellent corrosion resistance of over 1000 hours of salt spray (ASTM B 117). Chrome has much lower corrosion resistance (~ 150 Hrs) due to presence of micro cracking.

Performance: Comparing Hard Chrome to FLASH CARBIDE®

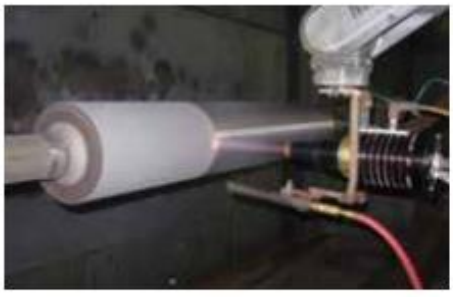
FLASH CARBIDE® coatings are significantly denser than chrome plating, plus chrome plating has micro cracking (PICTURE 1) within the plating layer which allows corrosive agents with high or low pH to penetrate the plating and attack the substrate. Micro cracking can be seen in the adjacent photomicrograph. If the substrate is ferrous, this leads to crevice corrosion and ultimately the failure of the plating by flaking and delamination. The porosity of FLASH CARBIDE® coatings is less than 0.6% and is not interconnected Picture 2). As such, thermal spray coatings provide a much stronger corrosion barrier than hard chrome plate.



Mach 3 flame velocity ~ 1800 mts/sec, Bond strength exceed 16000 PSI, Porosity 0.6% max, As coated finish < 1.6 Ra (super finished 0.05Ra)

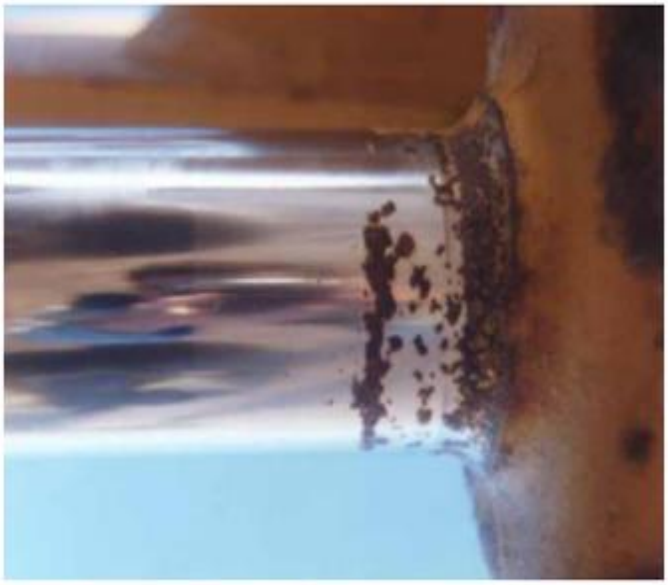
1. Hard chrome has micro cracksleading to pitting and corrosion

2. Flash carbide has no cracks and has less than 0.5% porosity and no through passage.

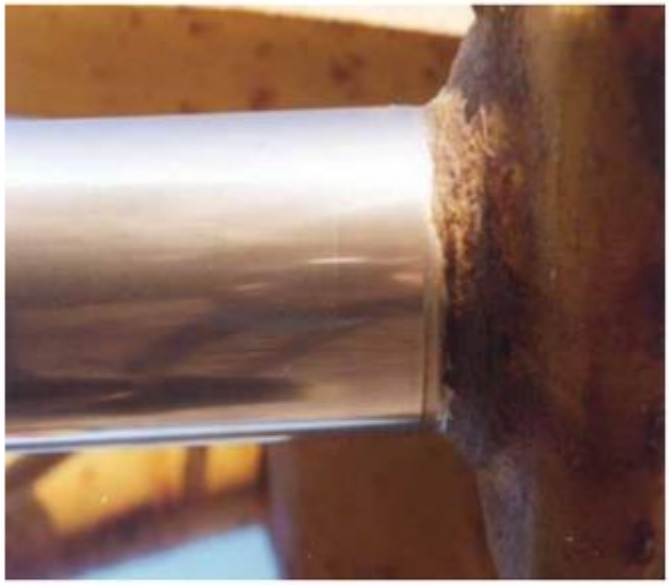


3. Flash carbide nano coating on piston rod

Substantial improvement in corrosion and pitting resistance. Mining Dozer piston rod.
(picture courtesy Caterpillar brochure)



Chrome plated Hydraulic Rod pitting after 400 Hrs



No pitting or corrosion after 1500 Hrs

Customizing the coating design such as increasing the coating thickness, or modifying the coating material composition (adding chromium or nickel to the powder composition), or using a post coating sealer can all further increase the corrosion barrier strength of a FLASH CARBIDE ® coating beyond 1500 Hrs. of salt spray test. Hydraulic and Piston rods are widely need this performance. (picture 3).

Chrome plating does have its advantages. One benefit of chrome plating is that it is a dip process. So, it is generally easier and more efficient to fully encapsulate a component with a dip process than with a line-of-sight process such as FLASH CARBIDE®. For components with complex geometries multiple set ups are necessary if more than one surface is to be coated.

Conversely for components with multiple areas to be coated and adjacent areas where coating is not allowed, FLASH CARBIDE® maybe the most economical solution. Furthermore, advances in Flash carbide coating Gun devices now allow deep ID bores to be coated. Deep ID bores as small as 3" can be coated with FLASH CARBIDE®

Common Applications

Thermal spray coatings have been used for years to replace chrome across a wide variety of industries. The aircraft engine and airframe industry took the lead early on replacing chrome with thermal spray coatings because of the increased component life. Coating resistance to fretting, wear, fatigue and corrosion make thermal spray coatings an economic and performance winner over hard chrome plating. Many other industries have quickly followed the aerospace lead. Some examples are mining, chemical and plastics processing, oil and gas exploration, printing, power generation, agriculture, and heavy machinery. Pump parts, diesel engine components, printing cylinders, and all kinds of rolls are coated with tungsten carbide and other similar metals instead of chrome.

Properties comparison

Measure	Hard Chrome Plate	FLASH CARBIDE ®
Bond Strength	6000 psi	>12,000 psi
Micro Hardness HV	900	1200-1400 (>74HRc)
Porosity	Microcracking	Less than 0.6%
Corrosion	55 Hours	>1000 Hours
Temp Limits	750° F	1600° F
Friction Coefficient Dry	0.22	0.20 (super finished)
Friction Coeff Lubricatedv	0.12	0.08
Attribute	**Hard Chrome Plate**	**FLASH CARBIDE ®**
Wear Life	Moderate	Excellent
Corrosion Barrier	Weak	Excellent
Fatigue Resistance	Low	Excellent
Cost	Low	Moderate
Environment Friendly	Poor	Excellent
Damage Resistance	Poor	Good
Anti-fretting resistance	Good	Good

Various industrial Applications of Flash Carbide:

Landing gear, Hydraulic piston rods and Cylinders, Feed screws for injection, Hydro turbine and steam turbine parts, Gate Valves, progressive Cavity Pump Rotors, Ball Valves, Cylinder Heads

Remanufactured Components

Seventy percent of the material cost and 80% of the energy costs are recovered when remanufacturing a component instead of replacing it with a new component. Remanufactured will last longer and perform better. In some cases, using tungsten carbide instead of chrome will mean the part will never need to be repaired again.

Summary

If your goal is to have machines running longer and at higher efficiencies, you should consider whether thermal spray coatings is an option for you. Consult a thermal spray technical sales engineer to see what would be the best material and process to improve performance. By engineering the right material and process you can expect longer life and better performance from your components.

About the Author:

Mr. P. T. Bindagi is a Metallurgist started as lab metallurgist with Unbrako Bombay and later in 1988 took hard facing and coating training at METCO USA. He worked with METCO for 19 years promoting Thermal spray in India and was instrumental in bringing plasma spray to private sector. Presently, he owns Spraymet Surface Technologies Pvt. which has spray shop in Bangalore and Pune offering complete range of coating services like plasma spray, HVOF, HVAF, PTA cladding.

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"Materials Science and Kitchen Practices"

- By Dr. B. Ashok

Dr. B. Ashok, Member ASM

We metallurgist often times help and support core industries as Automobiles, Heavy Engineering, Aerospace and wide variety of other industries in choosing appropriate materials and getting involved in varied metal related activities as Heat treatment, plating, coating, joining etc. in order to improve their product performance. It's time we look inward and examine if we are using health safe materials in our kitchen. Purely from scientific perspective an attempt is made to examine current kitchen practices to check if we are using the right materials.

1.0 Some Common Cooking Practices: As a first step we need to understand the requirements of materials used in every day kitchen practices from which we can arrive at appropriate material. Basically, Kitchen practices consist of 3 main process i.e., 1) Moist Heat Method 2) Dry Heat Method and 3) Combination method. Food Science / Home Science texts list over 12 methods of cooking. However, all these falls in the above 3 categories. In moist heat method, food ingredients are heated with water or steam (e.g., Idli, Sāmbhar etc.), in Dry heat method, the food is dehydrated as in roasting, frying or surface heating and in combination method both the methods are combined as in Biryani or Vegetable Pulav. Typically, in wet heating, max temperature of 95 deg C, in pressure cooker heating max temperature of 120 deg C and in deep frying max temp of 180 degree Centigrade is obtained.

2.0 Requirements of cooking utensils:

Based on cooking process and nature of food ingredients, the requirements of a good utensils are:
1) It should aid in efficient and uniform heat transfer
2) It should not contaminate the food with its toxic components
3) It should maximize the preservation of flavor, taste, minerals and vitamins.
4) It should be easy to clean post use.

The chemistry of cooking is that the raw food which is made of carbohydrates, proteins, fats, minerals and vitamins are softened by breakdown of collagen, denaturization of proteins, breaking up of long chain bonds as in fats etc. whereby the food is made edible. A variety of materials are used for cooking. Current usages from Indian context are Aluminum, Stainless steel, Copper, cast iron, Bronze, Teflon coated pans and plastics used mostly for packaging.

3.0 A Review of Materials Used In Cooking

3.1 Aluminum:

Most commonly used material in Kitchen for Moist heating/boiling or shallow frying as in Aluminum skillets. It's used as cooking pans, food storage pans and more commonly as Pressure cookers. Aluminum foils are also used for food packaging. Typically, foils are made of pure Aluminum of 1015 grade and other utensils of 3xxx, 5xxx and 6xxx grades. Also, Teflon coated pans as non-stick ware is also used. Aluminum as a material offers advantages as light weight, higher conductivity of heat, corrosion resistance and affordability. Surprisingly hot food packed in Aluminum foil can retain heat over longer time due to enhanced reflectivity of Aluminum foil, which can further be improved by having a food grade cardboard packing between food and Aluminum foil. Major negative point is the ingestion of Aluminum from the utensil by the humans through food cooked in Aluminum utensil. Aluminum is also present in baking powders, antacids and drinking water. World Health Organization (WHO) recommends toxicity limit of 2mg /kg/week of Aluminum in-take. Epidemiological evidence has indicated strong correlation between Alzheimer disease and increased aluminum intake. However, WHO studies on this aspect was inconclusive. Kidney diseases over long-term use of Aluminum have also been suggested, as most of the consumed Aluminum is excreted through urine. Some authors had claimed that hard anodized aluminum is safe. Hence although there is no conclusive evidence either way, the use of Aluminum as utensils is controversial. Product manual for wrought Aluminum utensils –BIS-1660- 2009, prescribes only visual examination and abrasion test for hard anodized aluminum utensils. However, the solubility of Aluminum in water increases both with temperature and Low Ph as when cooking acidic foods. It's simply not possible in household to do visual inspection of Aluminum utensils to check if coating has peeled or anodized surface has cracked. Similarly, Teflon coated Aluminum are even more dangerous as any peel of Teflon layer releases toxic fumes and compounds that are thought to cause typical Teflon flue, thyroid, liver problems and possible carcinogenicity. Although there is no solid scientific evidence for the same, it's worth to be prudent in avoiding them. Sticking of food to pan happens because of protein in the food forms weak Vander Waals bond with the metal ion, which is of the form of metal protein complexes or ligands.

3.2 Stainless Steel

Perhaps widely used in the kitchen right from water jugs, cups, food plates, heating vessels, variety of spoons and spatula etc. These are usually made of AISI 304 or better versions with 316L.For those with nickel allergy, ferritic grade AISI 430 (which is magnetic) is appropriate. This is also good for prolonged contact with mild acids (as Sambar, Rasam etc). Permissible intake of nickel per day is 1000 micro grams and that of chromium is 2500 micrograms. Stainless steel offers the advantages being corrosion resistant, sturdy and since it can be used up to 800 deg c practically any form of cooking can be done. The disadvantages are poor conductivity (which can be advantageous in keeping food hot post cooking) uneven temperature distribution and leaching of both nickel and chromium in presence of acidic foods. Fortunately Nickel and chromium toxicity causes only non-life threatening ACD (Acute contact Dermatitis). Some people are prone to nickel allergy. And as Stainless steel is corrosive with respect to chloride ions, Salts cannot be stored in stainless steel.

3.3 Copper:

Copper based utensils were used since ancient times. A variety of items as plates, water jugs, cups and in few cases heating utensils are used. Mostly pure copper and to a lesser extent brass and bronze cooking pots are used. One attractive property of copper is its superior thermal conductivity. It's five times better than iron and twenty times better than stainless steel. This means that the heat would be uniformly distributed and there would be no scorching. As copper stores heat well, food will stay hotter for long time. Copper cookware has antibacterial effect i.e., Bacteria and other microbes cannot survive as copper is toxic to them. Hence, it's excellent to store foods and water. No doubt that foods cooked in copper utensils have uniform consistency. However, copper is not at all suited for foods that are acidic as e.g. those which are tamarind or tomato based as they easily corrode in such media. Similarly in case

of salty foods being cooked in copper vessel, iodine from the salt forms iodides of copper. The salts formed by copper are toxic to humans. To overcome this problem some copper vessels are coated with tin. Tin has lower melting point of 230 deg c. Variants of copper as copper bottom, ceramic glazed copper, stainless steel coated copper is available in market. Copper bonds well with tin. But copper bonding with stainless steel is a mechanical bonding and may give away. Maintenance of copper utensils is not easy- they are scratch sensitive and require special cleaning. Long heating times in copper vessels can lead to copper toxicity. RDA of copper is 900 microgram per day. However, if brass vessels are used the leaching of zinc would apart from giving protective benefits can reduce copper toxicity by combining with it in our body.

3.4 Cast Iron:

Some popular cast iron utensils in Indian home are Frying pans (Kadai), Tawa (for making pancakes as Dosa, Roti etc), Dutch ovens, Grills etc.

Frying is a dehydration process. A good indication of the completion of the frying process is when the hissing sound during frying due to release of water molecules stops. There are culinary demands that foods are to be of rich flavor and crispy. This is achieved by Maillards reaction or browning reaction that happens at above 140 deg c. In cast iron pans this temperature can be achieved as it is poor conductor, it retains and traps heat for longer time. For example, in deep fried vada or finger chips or similar fried food or baking of bread, the outer brownish layer is due to the reaction between amino acids from proteins and reducing sugars from carbohydrates. Apart from giving rich and unique flavor and crispy taste, the brownish layer does not give any nutritive value. In fact, over frying or over baking can lead to caramelization which would be darker brown and carcinogenic as it contains acrylonitride. Hence it would be a good practice to discard dark brownish crust formed in deep frying or baking. And follow a low flame heating to avoid over frying.

One of its greatest advantages is that a cast-iron utensil is that possibly it's the only piece of kitchen utensil that noticeably improves after years of heavy use. (Many kitchens have cast iron utensil that are lasting for decades and it improves after every use.) It would be a good practice to do seasoning i.e., application of oil or butter in the cooking region of the utensil to minimize rusting and also make it nonstick.

Like other utensils, cast iron utensil also leaches iron during cooking and much more when cooked with acidic foods. However, here the iron leaching is beneficial to health. Majority of Indians and especially women are suffering from iron deficiency Anemia and cooking in cast iron is one simplest way to mitigate this health issue. In Canada and other countries hot drinking water is stored in Iron of fish shape (also called lucky iron fish) and taken as therapy by anemic patients. However, for those having Hemochromatosis (or iron overload), use of Iron based utensils is not recommended. Another disadvantage with cast iron utensils is uneven heating, especially when cooking involves surface heating. For e.g., Crispy Dosa would have only some areas of brown color and this brown color would be varied in intensity in different areas. Brownish regions have undergone Milliards reaction and hence seen local temperature of over130 deg C and whitish regions have seen far lesser temperature.

3.5 Plastics and Polymers

Some of the Polymers used in Kitchen are:

1) PET (Poly Ethylene Terephthalate) used in water bottles, fruit juice and aerated drinks bottles.

2) HDPE (High Density Polyethylene) used in milk cans.

3) LDPE (Low Density Polyethylene) used in reusable cans.

4) PP (Poly Propylene) used as Food containers

5) Polystyrene used as reusable cups, spoons and forks.

6) Melamine – Food trays, lunch boxes, Dinner sets, cups

Plastic offers the advantages of light weighting, durability and free of corrosion. However almost all polymers use Bisphenol A in their manufacture. Over repeated use it leaches out and especially accelerated with hot/acidic foods or microwaving and with fatty foods. Even some Aluminum bottles are lined with Bisphenol A. It is known to cause neurological problems in infants, chronic inflammation, insulin resistance and risk of heart disease. At household level, it's not possible to check if the Bisphenol-A additive is present. Hence it would be better to avoid them.

As per FDA advisory, Melamine (which is used as food trays in Trains, Aero planes, etc) should not be used for infants, serving of acidic foods or heating including microwave of food is prohibited. Plastics ages. So, they need to be replaced after some time.

3.6 Other Kitchen utensils

3.6.1 Silver has been used since ages as a kitchen utensil. In present times, it's used as food plates, spoon and Bowls. Silver foils are permissible additives as per several standards. In India Silver foils are used in sweet foods to give brilliant and pleasing appearance. In most families, the first food that the child eats would be from Silver plate or bowl. Royalties of those days used to eat in silver plates and use silver bowl for storing food and wine. The principal advantage of silver is that it's nontoxic and bactericidal. The silver ions kill all bacteria. This makes food fresh for long times. Strictly speaking except for Sulphur containing food as Egg, all foodstuffs can be stored in silver ware. But in most of silver utensil manufacture, approx. 8% copper is added. In these spoons and vessels, the taste of curd and buttermilk would be weird because of lactic acid reaction with copper.

3.6.2 Glassware as bowels or containers for storing wines, Pickles etc was used since ancient times. Glass being inert does not react with the food. Nor like Aluminum, promote bacterial growth. The flavor and taste of food is preserved. Wines stored in glass retain both flavor and texture for long years. Fruits preserved in glass bowl retain the flavor. However, FDA standards limits lead percentages in glass to less than 0.5% and are completely banned for using for infants as feeding bottles. This is because of leaching of lead from the glass. Glass being brittle has to be handled with care. Non leaded glass can be easily replaced with plastics for storage of food grains and they need to be stored in air tight containers.

3.6.3 Ceramic Ware Ceramics are used in mugs and storage containers. Nowadays ceramic coated utensil has become popular. Ceramic coated utensils can be used for any form of cooking. They can retain heat, have no reaction with food and non-sticky. The problem with these is that they are brittle, needs careful cleaning and handling; else it would be scratch prone and exposes the underlying metal - usually Aluminum. Apart from toxicity, this can also cause possible ingestion of chipped ceramic particle along with food.

Pure ceramic food containers are safe both for drinking hot beverages and storing such foods as salt, pickles and food grains. However, to improve aesthetics, the ceramic interiors are glazed to form smooth shiny surface. The glazing material consists of lead and cadmium, which has potential to leach into food over long period of usage. FDA bars usage of any Cookware or Bake ware having beyond a prescribed level of lead.

3.6.4 Pottery as Cookware

In ancient times clay pots were used for cooking. Clay pots are porous and permits natural circulation of air and moisture within food, retains aroma and flavor without loss of nutrition due to slower heating and airflow within food. Since they are alkaline, they neutralize the acidic food and make more healthier

and tasty food. And it requires little or no oil for cooking. Hence clay pot cooked foods are far tastier and more flavored than any other means of cooking. These clay pots are brittle and if not properly heated can crack. In present days these are used for storing and natural cooling of water in pitchers and as disposable cups for drinking beverages. These days clay pots are glazed to make it more aesthetic and durable. Glazing material contains toxic ingredients as lead and cadmium which is a matter of concern for their usage.

4.1 Conclusions

Except for lead and arsenic there is no robust medical evidence of toxicity of other metals. Many of the potential toxicities are built over years and decades before they manifest as disease. Most of the RDA (Recommended Daily allowances are of 500 to 1000 micro gram. There is practical difficulty in conducting long range tests running beyond 10 years. Hence, it's better to err on the side of caution and go by our present scientific understanding. Normally materials processes whose requirements are of the order of microgram accuracy are either carried out in Vacuum or Inert gas (as in melting) or Clean room of level 4 (as in composite lay up shop). None of these process are used in normal cooking. Hence all the more importance to be paid to cooking utensils. Some of the conclusions are:

1) Say no to Aluminum utensils for cooking and restrict it to storing food. For Cooking in Aluminum pressure cookers, better alternative is to place steel container inside Aluminum Cooker.

2) Stainless steel is versatile and causes least toxicity.

3) Copper is to used only for storing non acidic food.

4) Say No to Nonstick cookware. Instead, non-sticking characteristics can be achieved by better cooking techniques as low flame heating, constant stirring and oil interface between food and the vessel.

5) Replace Plastic containers with nonleaded air tight glass containers for storing groceries and also for drinking cups.

6) Hot foods stored in Aluminum foils must be consumed within four hours of packing and preferably interfaced with food grade cardboard or banana leaf, else there would be massive growth of bacteria which could lead to possible food poisoning. Similar interface can be made with plastic food plates.

7) There is a need for educating both Food makers, Food providers and Society at large in choosing right materials for kitchen process. This would lead to eating foods which are healthier beyond all reasons of doubt.

About the Author:

Dr. B. Ashok is Retd Deputy Project Director in ADA. He is an expert in shape memory alloys and active researcher in other aerospace materials and functional materials- its Design and application. He is very active member of ASM and has championed for its cause. He is also involved in guiding several PG students. He has several research publications to his credit.

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Special Events & Highlights

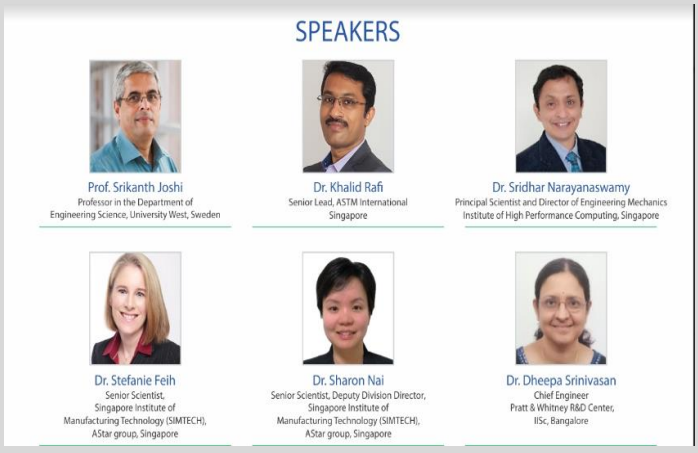
Calendar of Events

Seminars / Workshops

"Additive Manufacturing for Gas Turbine Engine Applications – Organized by
ASM International Bangalore Chapter
ASME, Gas Turbine India Chapter
Indian Institute of Metals – Bangalore Chapter

Date / Venue	April 23, 2021 @ Zoom Online Meeting Platform
Speaker / Programme	

Time (IST)	Title	Speaker
16.30-17.05	Electron Beam Melting of Alloy 718: Processing, Post-treatment & Properties for Aerospace Applications	Prof. Shrikant Joshi
17.05-17.40	Additive Manufacturing Standards for Aerospace Qualification and Certification	Dr. Khalid Rafi
17.40-18.15	Virtual Testing of Materials, Structures for Additive Manufacturing Processes	Dr. Sridhar Narayanaswamy
18.15-18.50	End to end additive manufacturing solutions (from research to application)	Dr Stefanie Feih & Sharon Nai Mui Ling
18.50-19.25	Challenges in Qualifying Additive manufacturing for GT components	Dr. Dheepa Srinivasan



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Technical Lecture / Talks

"Vacuum Heat Treatment – A Paradigm Shift"	
Date / Venue	February 13, 2021 @ Ring Central Online Meeting Platform
Speaker / Programme	Sri K. Thyagarajan, Retired Scientist-G, DRDL, DRDO, (Min. of Defence), Hyderabad

Forth Coming Events/Attractions:

We are very happy to announce series of program lined up in the present quarter (May – July 2021):
1. Formation of new Student Chapter at RV College of Engineering, Bangalore and SJB Institute of Technology, Bangalore.
2. Professional seminar series "Repair Technologies in Gas Turbine"
3. Technical Talks on the topics, Aluminium alloys-Fabrication and applications, Light weighting Approaches- A Materials Perspective, How to run Small and Medium size companies?, Nanotechnology, Super alloys, Stainless Steels, Flash Carbides coatings, Hard Chrome plating etc. All the Talks will be delivered by eminent speakers drawn within ASM Bangalore chapter community and outside.
4. Technical Talks and workshops exclusive for students.
5. And Many More…….

Members, are you interested to give/organize a Technical Talk in the areas of your interests?

(OR)

Would you like Bangalore chapter to organize any Talk/workshop of your interests….Please feel free to write us an email: asmblr2015@gmail.com

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WELCOME to ASM Bangalore Chapter Family

Bengaluru Chapter cordially welcomes the following New Members who joined during the period – From 1st February 2021 to 30th April 2021: We look forward for your active participation and contributions to various programs conducted by the chapter.

Sl. No.	Names of New Members	Company/Institute/college
1	Prof. Dr. Ajay Kumar	Indian Institute of Technology, Tirupati
2	Mr. Ajayakumar Ratnakar	VST Tillers & Tractors, Hosur, Tamil Nadu
3	Prof. Dr. Parvati Ramaswamy	Christ University, Kengeri Campus, Bangalore
4	Mr. Priyanshu Bajaj	Metal 4 Printing, Bangalore
5	Mr. Mallappa Kaggod	R. R. Precision (I) Pvt. Ltd., Bangalore
6	Prof. Dr. Surendra Kumar Makineni	Materials Engineering Department, IISc, Bangalore

OBITUARY

Late Sri Ajikumar was a Managing Director of M/s. Aswathy Heat Tech. Pvt. Ltd., Peenya Industrial Estate, Bangalore. A leading Heat treatment furnace manufacturers based out of Bangalore. He was a Member of ASM (I) Bangalore Chapter.

The Office Bearers and Council Members of ASM (I) Bangalore Chapter pray GOD to give enough strength to the bereaved family to cope with this great loss. May his soul rest in the heavenly abode.