

My Tryst with Indigenous Armour Development



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Born little after India's independence, as a child, I used to imagine and feel that I owned the whole great country. My father was a respected school headmaster who used to get respectful salutations from members of nearly every house situated all along a seven kilometer long path of walk to his school through hills and fields. He would reciprocate with appropriate affectionate words without stopping his walk. It was a thrill to walk with him. My mother would often be cheerfully singing tunes and hymns while taking care of the small farm, all the workers, children, cows and guests with infinite patience and love. It was a great joy to do every type of work to help her and receive her blessings. Early in the morning, every day, father would gently wake me up by teaching me shlokas, maths, words, spellings and grammar while sitting by my bedside even as I lay on the bed with closed eyes, and end the day similarly at night. This process I believe gave me many things, including a habit of not wasting a single moment from the time one wakes up to the moment one falls asleep.

At the age of 14, I joined Sri Ramakrishna Mission Balakashram at Mangalore where the rigorous discipline of perfectly doing all the chores along with studies toughened the mind-body system. Here I had the chance to tutor (free) classmates and younger students, which increased my grasp on the subject and also strengthened my self-confidence.

In 1967, I joined the B.Tech programme at IIT Madras. Here, I concentrated totally on understanding the principles and deeper aspects rather than on securing grades. This quest made me read a large number of books and to some extent journals available in the Institute library where I would often sit up until it closed late in the night. After B.tech, I secured admission with scholarship to do PhD at Washington State University, but, when I learnt that USA had sent its 7th fleet in readiness to attack India during the Bangladesh conflict, I changed my mind. Instead, I went to IISc Bangalore to study M.E from where DMRL recruited me.

At DMRL, for the first six months or so, I visited all the groups and glanced through all the books and journals and generated hundreds of research ideas. Initially I worked on TEM and intermetallic alloy systems. One day, Dr.V.S.Arunachalam, who had joined as our new director called me aside and in his characteristic excited way asked me whether I prefer to work on pure science and maybe hope to get a Noble prize one day, or work on an important development work. Because of the training at IIT, proud to be an engineer, I immediately chose the latter path. Next day Dr.Arunachalam called me to his office and excitedly explained the scattered notings in his little diary about the Chobhamarmour trials shown in a hazy way in England to the visiting Chief of Army Staff and asked me if we can quickly develop and demonstrate a similar one. Though I knew nothing, I sensed that every atom in my body was excited.

First I made a quick dash to TBRL, ARDE and weapons related laboratories studying all available reports and papers to understand the nature of the threats and their operating principles and mechanisms. To find some solution, I went into a contemplative enquiry mode and scanned the rather difficult journals such as "Journal of Applied Physics" at the libraries in IISc and TIFR to look for sound principles based on which one can construct appropriate armour materials on our own ab initio. Various ideas such as Konda's effect, deflection of shockwaves, splitting of the jets, avoiding momentum multiplication, using extremely high viscosities of glass like substances, facilitating lateral dispersal of momentum and energy, breaking up the projectiles or deflecting the projectiles etc. were conceived. Appropriate tailor made materials and structures were thought of. It was realized that while in most engineering materials and applications we need to maximize strength, sometimes strength and toughness, in armour we need to maximize the product of strength, ductility and the volume that participates in energy absorption. Increased speed of plastic wave and increased homogeneity of strain that accompanies it is critical. These are unique requirements. Further, it was observed that while homogeneous deformation is key for maximizing energy absorption, inhomogeneous flow is desirable for momentum absorption such as in the case of HEAT and for turning or breaking the shots. For dissipating or absorbing shocks, layered structures should be preferred. Accordingly, many new materials and structures were conceived and made.

The first results of the trials on the HEAT rounds came within a few months and, may be for the beginner's luck, were truly fantastic. Soon, larger samples were made and tested at PXE Balasore. The plates not only defeated the HEAT rounds but also withstood the KE, APDS rounds. The round was trapped inside. To see what happened to it, the plate was brought to DMRL. It was cut open the same night to see what actually happened to the shot. I and Dr. Arunachalam walked from Lab Quarters to DMRL at well past midnight to examine the plate from inside. To our shock, the shot was not inside, hiding, but had actually broken up to fine dust!

It was an exciting beginning. A comprehensive and confident programme thus began at DMRL.

Using a variety of starting materials such as ceramics, hard steels, tough composites, and energetic explosives, the armour programme advanced in many directions to meet a host of challenging requirements. Success after success came in the form of armour system for MBT Arjun and its continuously improving features. For T-72 Ajeya and for T-90 the required armour technology was developed indigenously. Armour for light vehicles, helicopters and many other applications like lancer helicopter, Vijayanta tank, ICV-Abhay and Mi-17 helicopters also emerged out of the programme to meet the requirements. It gives great satisfaction and excitement to me and my research team.

More than 20,000 tonnes of various armour materials have been produced to meet the various requirements. An Armour Technology Centre has been set up in the 700 acres of land specially acquired for the purpose.

There are a few critical factors which I believe have contributed to the above successes in the trust with indigenous armour development:

1. Full trust, support and freedom provided by the organization.

2. On my part, I kept myself in the excited state throughout for over three decades and spread the excitement to my colleagues. I tried to give full credit to my colleagues. We used to analyze the less successful results and come up with a solution plan next day itself to work on.

I used to keep a notebook and pen on my bed to scribble ideas that often turned up after midnight. Practicing the art of lateral expansion of horizon to generate new ideas and delving deep for robust analysis and experimentation to confirm the utility of new ideas was the method. I used to say Jai Hind before going to bed every day and pray for success of my project every morning.

1. Participation by industries in a deeply collaborative way with implicit mutual trust.
2. From the user's side, the area of protection is one thing that is close to the heart of every member from soldier to the chief, and evokes spontaneous, deeply supportive and encouraging responses.

My heartfelt acknowledgement is to my family and work related family whose unfathomable depth of emotions, support and commitment has enabled the attainment of deeply satisfying results in my tryst with destiny in the service of the nation, which reconfirms my childhood feeling that I indeed own the whole country is correct.

I also acknowledge that while something has been done, there is a lot more to be done and forever so.

Jai Hind