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Keeping the Industry Informed

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INNOVATION IN ROADWORKS

ECOROADS-stabilised surface before priming at Chamwino, Dodoma

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From the Editor

When Minister for Works Innocent Bashungwa addressed the Tanzania National Roads Agency Workers Council Meeting early this year, he challenged the agency to find remedy for premature failure of the country's tarmac roads. The basis of that challenge was quite clear: the Government is spending huge sums of money to repair roads too soon after they have been built and so it is time for engineers and contractors to at least discuss possible causes and solutions to the intractable problem. We can all take it up: Is it poor design, workmanship or choice of materials? Anyway, whatever it is, ***The Contractor*** has come to learn that it is, apparently, a global issue.

Government planners see roads as essential arteries through which an economy grows - connecting cities and communities with one another and ensuring smooth transport for people and goods; and so impact almost every economic activity. By linking producers to markets, workers to jobs, students to schools, and the sick to hospitals, roads are vital to any development endeavour. For this reason, the World Bank lends more for roads than for education, health, and social services combined ***(https://blogs.worldbank.org/en/developmenttalk/how-roads-support-development).*** However, while they bring socio-economic benefits, roads also cost a lot of money to keep them passable throughout a year.

It is thus understandable when the minister presses incessantly for effective solutions to premature failure of this vital infrastructure and The Contractor feels obliged to join in the search by providing an awareness platform.

Authors have produced articles herein that shed light on possible methods of dealing with the issue. Among them, one has reviewed a professional paper by Indian engineers who provide insight and assessment on a novel road rehabilitation technique in which a flexible pavement section and a predetermined portion of the underlying materials are crushed, pulverized or blended, resulting in a stabilized base-course for a new road. The article first highlights the basics of road building and makes interesting observations borne out of practical implementation of the technique on a typically busy road.

It is exciting to also read about a product from a locally-based company ECOROADS Tanzania, which facilitates the rebuilding of roads using a patented chemical called ECOROADS. The article describes this product as a "multi-enzyme road-base construction and soil-stabilization product." It quotes manufacturers as saying the product helps to increase the strength, density, and durability of roads efficiently and cheaply. A notable plus to other qualities stated are its eco-friendly characteristics.

As we perused the global press for some more insight on possible ways to address premature failure of roads, we were delighted to learn that paving roads with plastics is another novel technique for the task! Apparently, roadworks in which waste plastic is melted down and mixed with paving materials are becoming more common around the world, notably in South Africa, Vietnam, Mexico, and the Philippines. According to the press, these roads have the potential to perform as well as, or even better, than traditional roads as they are stronger and more durable in respect to loads and rutting, can tolerate wide temperature swings, and are more resistant to water damage.

As many road stakeholders are looking for a solution, it is probably safe to hope that the days of premature failure of roads are numbered.

Cover photo: *SGR Bridge at Ilala, Dar es Salaam. Photo from SIKA Tanzania.*

From the Desk of the Registrar

Dear Readers,
I salute you all in the name of the United Republic of Tanzania!
I thank our Almighty God for His wonderful mercy as we mark the beginning of another financial year, 2024/25, and a chance for me to once again extend to you, warm greetings through this edition of The Contractor, which is dedicated to innovation in road construction.

Innovations in general, and in road construction in particular, have had a substantial positive impact to communities and to the road construction industry, by boosting economic growth and improving quality of life. However, most contractors, employers, and other stakeholders in road construction, are probably not quite familiar with innovative activities that continue to improve road construction activities and competitiveness.

The term innovation, as used in this edition, generally applies to application of appropriate resources – including recycled materials - to enable construction, rehabilitation and repair of roads cheaply, efficiently and without or with minimal damage to the environment.

Various stakeholders have noted that increased innovation with regard to road construction materials, along with the expanding information-sharing between developing and developed nations, have brought about new opportunities for achieving better ways of building of asphalt-surfaced roadways and economical optimization of road works supervision and administration. It should be noted that one important factor that renders acceptability of any solution to road construction stakeholders, is its zero impact or low-impact, on the workers and the environment. I am, therefore, pleased that indeed this factor lies at the heart of the techniques selected for this issue.

One of the innovative solutions presented is ECOROADS - a technology which is said to address both the shortage of cheap materials for road construction and rehabilitation while being friendly to the environment.

There is also a recycling technique known as Full Depth Reclamation that addresses the intertwined issues of premature road failure and the huge cost of rehabilitating damaged road sections. It can be used in the rehabilitation of a road section by utilizing in-place materials of an old pavement, thereby saving money.
However, innovation, as presented, is not limited to technological advancements and encompasses novel approaches to problem-solving that are often driven by a combination of factors, including a desperate need to provide a service in challenging circumstances. In this regard, The Contractor is paying tribute to the many drivers and transport operators, who devised various innovative - albeit unconventional - techniques to bring crucial goods and services to the residents of Tanzania's southern regions which were virtually inaccessible in the recent past. The then-and-now feature about the Mtwara – Mbamba Bay Road depicts the Government's belief that, truly, infrastructure is key to development.
I hope this issue will help to elicit in you, a heightened interest in searching for technologically, economically and ecologically appropriate solutions for building, rehabilitating and repairing the country's roads.

Karibuni!

R. Nkori
Registrar

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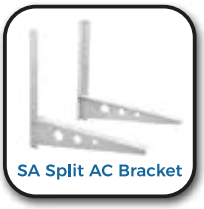
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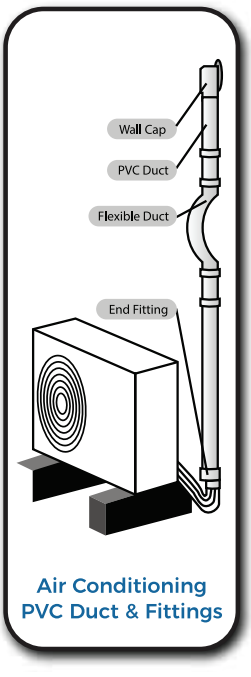

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Contract management training stresses essence of best practices for contractors, employers

The Contractors Registration Board (CRB) training on contract management has brought to the fore the need for contractors and employers to embrace best practices in their relevant fields of operations as they are an important factor on their businesses' bottom line, The Contractor has learnt.

This came to light in the remarks of CRB's Head of Research and Development, Eng. David Jere, when he addressed participants at a three-day training at Mkandarasi Place in Dodoma, aimed at equipping contractors and employers with knowledge and skills needed to improve the way they manage contracts.

Eng. Jere said CRB placed great importance on the essence of the training, saying, "Your contracts are crucial business documents which guide your relationships and agreements with the other parties, so knowing how to adhere to them would ensure compliance with contractual obligations such as meeting deadlines."

He added that the Board prepares and makes possible for contractors to attend the practice-oriented training with content that included the roles of parties to contract, time and cost control, insurance and securities, default and termination, claims and dispute resolution, because "it is a cost-effective way of enhancing knowledge towards acquisition of efficiency and productivity in works."

Eng. Jere added: "A bona-fide business person is one who adheres to best business practices, including paying tax and being averse to malpractices," before telling the participants that it was also important for them to be aware that, "how you handle your contracts can greatly affect your bottom line in many ways."

Eng. Emmanuel Kachuchuru, presents on Contracts Management Skills

Participants follow a presentation at a Contracts Management

Participants follow a presentation at a Contracts Management

Towards the end of the training The Contractor had a chance to hear from some participants about the training. Gunilla Nyagawa, business manager at Africentric Company Ltd and one of the participants, said the training enlightened him on many aspects of his work at the company, "especially the crucial role of time management, that a good contractor must essentially keep an eye on the time stipulated for a project," he said, adding that the training also offered him an opportunity to discuss various issues face-to-face with professionals and others who easily gave answers for issues which had been bothering him for quite a while.

"Sometimes you would not be aware that you needed certain knowledge until a fellow participant asked about it and got an answer, so attending training has many benefits even if you think you know a lot about a topic," Nyagawa said.

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Eng. Alex Kijugo of RUWASA probably summed up the sentiments of many participants when he said he was now empowered and felt more confident to handle works contracts.

"Some contractors miss out on their rights because of lack of knowledge on some aspects of their contracts," he said adding that he wished more and more contractors and employers get to see value in attending such training.

The training, which took place from 24 to 26 July 2024, was attended by 90 participants, including contractors and employers of contractors from 13 regions.

Features

ECOROADS: Innovative soil stabilization product brings new solution in roadworks

Roads and road networks are an important part of infrastructure that is crucial to a country's development endeavours, enabling the movement of people, goods, and services. But equally crucial is the manner of their construction, rehabilitation, maintenance and repair because when they deteriorate, governments have to spend heavily in road works.

As important as they are, roads can generate major complaints and resentment when they are not passable. While a well-built paved road can be virtually maintenance free for years after construction, a poorly-built paved road can require continuous maintenance until deficiencies in construction are corrected. It is a case of build a road to last or be prepared to spent huge sums of money and time repairing it. In both, however, cost-effectiveness is the desired characteristic of any solution.

This feature is highlighting one of the innovative solutions which is gradually finding application in some of the country's roadworks: ECOROADS - a cutting-edge technology from Terrafusion International, Inc which says the product not only addresses the infrastructure needs but also "helps to reduce construction costs by up to 60% through a combination of advanced techniques and technologies that revolutionize roadworks."

The technology, which was piloted in the country on the upgrading of a 1km Ilazo Road to bitumen standard in Dodoma City, by Isabhi Company Ltd, in 2022, is a multi-enzyme road-base construction and soil-stabilization product.

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Ilazo Roadworks, Dodoma

Ilazo Roadworks,

According to its manufacturer, the technology helps increase the strength, density and durability of roads and road bases efficiently and inexpensively. Essentially, its chemical composition works to change the properties of the soil thereby creating a solid and durable permanent road base, the manufacturer says.

When The Contractor visited Ecoroads Tanzania at their offices in White Star Tower, Mikocheni in Dar es Salaam, we were pleasantly surprised to learn from Luciana Wolff, the manager, that following the Ilazo project, which was successfully completed in 2022, Ecoroads is also being applied on other projects, including 6.9km Abedi Amani Karume Road, Chamwino, Dodoma, being implemented by Kings Builders Limited; 10.4km Sawala-Mkonge-Iyegeyo-Lulanda Road, in Mufindi, Iringa, being implemented by Clask Tanzania Limited; and 32km Utete – Kingupira, Rufiji, Pwani, being undertaken by NRST Ltd Civil Works Contractor JV -

Mixing soil with Ecoroads solution to obtain a uniform soil mixture with optimum moisture content at Chamwino, Dodoma

According to Ms Wolff Ecoroads is non-caustic, non-corrosive, non-combustible, ecologically responsible "and so safe that even if the user ingests it accidentally he or she will be free from harm."

Dilution of Ecoroads with water, in specific volumes, before

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She added that the product can be used in many different applications such as general construction, rehabilitation, maintenance and repair of all types of roads, pointing out that while many of the ongoing projects are for tarmac roads, some or sections of some are for roads with non-tarmac surfaces or what she called roads with 'gamba gumu.'

Its manufacturers say one of the core principles of **ECOROADS** is the utilization of local in-situ materials which adds to its environmentally friendly characteristics. According to their publicity material, "By incorporating sustainable materials and construction methods, it minimizes the environmental impact of road projects, contributing to greener and more eco-friendly infrastructure development."

Compacting the base surface after the soil has been mixed with

Furthermore, the manufacturers say the cost-effectiveness of **ECOROADS** has a basis in durability and longevity in that "roads built using this approach stand the test of time, reducing the need for frequent maintenance and repair."

In a nutshell, the publicity materials say its notable benefits include:

1. Cost-effectiveness

By significantly reducing the need for imported aggregates, ECOROADS saves up to 40% on the cost of building a road. During construction of the road base the product can stabilize and solidify local soil mix, increase soil strength, stability and durability, further allowing reduction of required asphalt or concreate topping layer.

2. Increase in soil density and load-bearing capacity

ECOROADS "cementation" action increases the soil load-bearing characteristics by promoting a quicker binding of soil particles into a highly dense base, increasing strength and load bearing capacity. This creates a road base with strong ability to resist effects of erosion and mechanical forces.

Compacting the base surface after the soil has been mixed with Ecoroads solution at Mufindi- Sawala- Lulanda Road, Mufindi

3. ECOROADS can be applied over a wide weather and locale range

4. ECOROADS is easy to use

The product is easy to apply and requires no special equipment or procedures: Simply add the liquid concentrate to water in a sprayer truck, mix into the soil by road grader, then compact the treated soil.

5. Easy to handle and store

ECOROADS is a non-toxic and non-corrosive liquid concentrate which does not need special storage or handling equipment. However, prior to any operation, it is essential to perform laboratory analysis of the soil to determine soil particles distribution, plastic limit and the optimum moisture of the soil mix.

Note: before applying ECOROADS, make sure that structural materials which are planned for use in construction of the road base have a size distribution that will result in good load bearing values and contain approx. 15% to 30% non-granular fines (-200 mesh size and cohesive in nature). Prior to construction, field testing is necessary to determine suitability. Some clays and

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"fines" are silty in nature and are not useful for road construction. Also, excessive fines can cause problems as a result of high plasticity and/or low load bearing value.

It must be noted also that ECOROADS can be used effectively over a wide range of geological areas and soil gradation mixes (aggregate sizes). According to the publicity material, "To achieve effective stabilization, materials containing approximately 20% cohesive fines (non-granular) have been found to be satisfactory although excellent results have been achieved outside this range. Additionally, the soil should contain a wide range of material sizes to provide shear strength and internal friction which increases load bearing values. This product has proven useful over a wide range of soil types."

Compacting the base surface after the soil has been mixed with Ecoroads solution at Mufindi- Sawala- Lulanda Road, Mufindi

Following is a step-by-step presentation of how to apply the technology, as per the manufacturer's manual:

STEP 1

Blade or rip the existing road to a minimum depth of 17-20 cm and then windrow the loose material. If the road requires greater depth, work the material in the lifts. Check the overall gradation of the material to ensure it is within the design limits.

STEP 2

Dilute **ECOROADS** with water in a water tank. For each 25m3 of the road base material add one litter of **ECOROADS** to the amount of water that should be calculated to obtain optimum moisture. Spray both the bladed surface and the windrow to obtain optimum moisture.

STEP 3

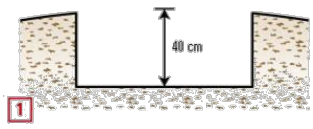
Mix the **ECOROADS** treated material in a windrow using a grader blade, working the soil mix back and forth to blend in the applied **ECOROADS** from water tank. If the material is too wet, blade longer to make it dryer. If too dry, add water without to bring the material up to optimum moisture. After thoroughly mixing spread the material to grade. Depending on the weather conditions, treated soil mix can be left in windrow over night to allow complete moisture absorption. This will result in better compaction with less effort. Blade treated soil mix to create road level and crown surface. If your soil mix dries too quickly, spray surface again with diluted **ECOROADS.**

STEP 4

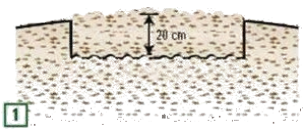
Preferably use heavy compactors (12-18 tons) with pneumatic roller. Vibratory rollers may be used for the first and second passes, however further compaction should be done without vibrator action to avoid cracking and obtain maximum density.

Application of **ECOROADS** is easy as it requires no special equipment and no complicated training. After 72 hours of drying with normal dry weather, the road is ready for use or for application of any desired topping, such as asphalt or other surface coating. To achieve better bonding with applied topping materials, it is necessary to moisten the surface by spraying diluted **ECOROADS** with a dilution rate of one to ten thousand (1:10,000).

Comparison of construction methods



Excavation trench in a depth of **40-60 cm**



Scarification the existing soil Excavation in a depth of not more than **20cm**

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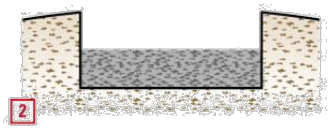
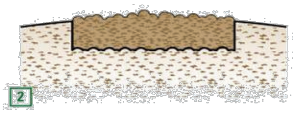
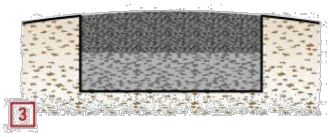


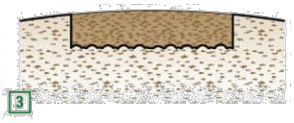
Delivery and embankment of blended stone materials for the sub-grade construction



Spray Ecoroads deluted water, then level treated soil mix after mixing



Delivery and embankment of selected blended crushed stone materials for base course construction, application of a wearing course according to the nature of the road



Compact leveled road, application of a wearing course according to the nature of the road

Work on 32km Utete – Kingupira Road, Rufiji, Pwani

According to the manufacturer, ECOROADS has proven to be effective for many kinds of road works around the globe with various soil types and geological conditions and requires no special equipment and no complicated training. In Africa it has been used in Malawi, Zimbabwe, Zambia, Kenya and Angola.

If roads could talk: Reflection on roadworks along Mtwara – Mbamba Bay Road

If roads could talk, the Mtwara – Mbamba Bay Road would have many stories to tell – probably to surpass those in the Arabian Nights. They would reveal to us that the term innovation embraces many definitions, including the process of bringing about new solutions that have a significant positive impact in addressing unmet needs, the resilience and ingenuity of drivers, that vehicles can have many lives, and that governments, engineers and contractors spend sleepless nights to make them passable. But only people talk and give insight.

Sometimes insight comes at the most insignificant of times and for this feature, it came via two sources: an almost obscure publication carrying a story of Katie Valliere Streit, an American lady who obtained a PhD in History from the University of Houston, having researched on "The history of automobility and state development in southern Tanzania during the nineteenth and twentieth centuries," and the narrative of Eng. Buberwa D. Kemibaro, in LinkedIn, about his experience of working as Assistant Resident Engineer on the Matemanga – Tunduru road project. The two stories combined well to provide an interesting backdrop for this feature.

Roadworks everywhere are undergoing a positive transformation thanks to a surge in innovative technologies and materials. From eco-friendly pavements to new methods of rehabilitating and maintaining roads, the future of road construction is exciting. But road construction also has a human interest story, as it touches many lives – residents, drivers and travelers, contractors and engineers

In Tanzania, road construction is evolving, with impressive structures coming out regularly. As of December 2023, the total road network in Tanzania was 37,226 kilometres of which 36,211 are classified as national roads and 1,015 as other roads. But many young readers - especially the urban dwellers – have no idea what the places hosting those impressive infrastructures used to look like; how arduous it was to cross those rivers, to drive on those muddy or rugged terrains. As a result, they probably don't give contractors the respect they deserve – partly because works on very long roads are implemented piece-meal- wise and so take long to be concluded. To help them appreciate the big

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strides made in a relatively short period, The Contractor is using the observations made by Katie Valliere Streit as she travelled on the Masasi to Songea section, and Eng. Kemibaro, who is quite appreciative of the opportunity he got to work on part of the now-famous Mtwara – Mbamba Bay Road. The musings of these two personalities, which complement each other, were intriguing enough for us to want to fill in some missing bits using other sources and to report on what has happened to this important road since.

And if vehicles could talk…

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From the outset, Ms Streit surmises that her travelling on public transport in Tanzania altered her perception of the ways in which infrastructure deficiencies impacted livelihoods in the nation's southern region, while Eng. Kemibaro, on his part, showers praise on the 58km Tunduru – Matemanga roadworks, which, he says, made a big impact on a small and quiet town of Tunduru, in what geologists call the East African Gemstones Belt and at about the midpoint of the Mtwara Corridor. He is familiar with most of the corridor as he often drove to Songea to consult with Tanroads.

Ms Streit's story is centred on the road journeys she did in the area in 2015. First, having read about horror stories of road travel in southern Tanzania, she was surprised to find the opposite while travelling along tarmacked roads from Mtwara to Lindi and Lindi to Masasi. She would soon meet the horrors on the Masasi to Songea road – the focus of her dissertation. The 194 km stretch from Masasi to Tunduru was indeed horrible by the account of other travelers in 2015 and when it finally got rehabilitated to tarmac level, the fact travelled far and wide: Openstreetmap.org happily reported that "Tunduru-Masasi Road is paved now, and has a new bridge." Such was the relief - considering the bridge is over River Muhawesi, reputedly the gemstone cradle of Tunduru District, 162 kilometres from Masasi.

As shown, Masasi – Songea Road is about 460 km long and consists of the following sections: Masasi – Tunduru (194km), Tunduru – Matemanga (58km), Matemanga – Namtumbo (136km) and Namtumbo – Songea (74km).

While Ms Streit's source of interest in the topic is not obvious, we note that at this particular time, the Government had recently commissioned a Chinese state-owned construction and engineering company – China Henan International Cooperation Group (famous as CHICO) - to construct a tarmac road from Masasi to Songea – a fact she only makes a cursory remark about - on which she took 15 hours 30 minutes to complete a 460km journey in 2015. We find it irresistible to report that today, Google Maps says the same journey takes 6 hours 45 minutes!

Matemanga to Tunduru section on Masasi – Mbamba Bay Road [Photo: Buberwa D Kemibaro]

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The ***Contractor*** discovered that by June 2016, however, some American couple, who travelled on the 267km Tunduru – Songea section, happily drove on about 40 km of strong tarmac both out of the gemstone-mining town of Tunduru and into Songea, "while the rest in the middle was under construction – a sign that in a few years the whole road would be complete, opening up this area in the south-east of the country." It is remarkable that the portions out of the two towns were built to tarmac level so soon after she had made the trip as her story is devoid of the commotion usually associated with roadworks – except one photo of what looks like a side road. She does not appear to have encountered any road works on the entire journey.

Section of 267km Tunduru – Songea Road, 9th June 2016 [Photo: American couple]

Nampungu Bridge on the Tunduru – Matemanga Road, June 2016. To the right, a new bridge is under construction but was not mentioned by the couple who took the photo!

From left: Old Nampungu Bridge, Eng. Buberwa Kemibaro (with hat) and the new bridge [Photo: Buberwa Kemibaro]

The American researcher says she finally understood the frustration locals expressed at the "government's inability to construct tarmacked roads," wondering how could anyone access outside markets and conduct profitable businesses under such conditions? She wondered, according to her account.

Masasi-Songea Road, 2015. Photo and caption by Ms Streit – who said nothing about any roadworks!

From her moving account, which we have edited for space, gradually, we started to see sense in the saying that challenge is mother of innovation: "I started to admire the innovation and fortitude of the drivers navigating the horrendous road for the benefit of themselves and their communities. "I reflected upon the technological knowledge of drivers and mechanics forced to find innovative ways of repairing vehicles in transit and/or when replacement parts were scarce. I also contemplated the initiative and innovation local communities demonstrated for over a century in the face of inadequate infrastructure," Ms Streit says.

Challenge is mother of innovation: gravel dealers or roadworks on a section of Mbinga – Mbamba Bay Road? June 27, 2014

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She concludes: "My interviews confirmed that individuals throughout southern Tanzania utilized automobiles [and the road] as tools to create dynamic, interregional, socioeconomic networks," she says, before adding: "I found that southern Tanzanians not only appropriated and adapted imported technologies to fit their needs and desires, but they developed unique methods and systems of constructing, maintaining, improving, and transforming mobility technologies and infrastructures so as to better pursue opportunities locally, regionally, and internationally." Although her narration was short on physical evidence, she made an apt observation which, we think, bestowed clarity on differences of spotting 'innovation', between the two observers - a historian eager to extract grievances from travelers, drivers as well as residents, about a terrible road, in order to complete her thesis, and an engineer eager to show the outcomes of his roadworks.

Eng. Kemibaro, says the time taken to travel from Tunduru Town to Songea Town has been cut down from the unpredictable, during the rainy season, to just under 4 hours - a welcome relief to drivers and travelers whose plight of yesteryears is aptly summed up by him thus: "In the recent past when the public transport from Tunduru to Songea comprised of mostly 4-WD vehicles, during rainy seasons," he says, "all able-bodied male passengers were charged a lower fare as they were expected to help dig out mud, lift and push when the vehicle they were traveling in got stuck in the thick mud!"

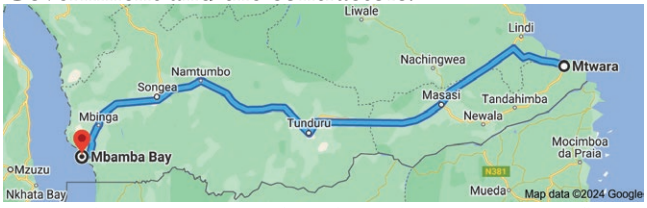
The ***Contractor,*** on its part, finds it quite remarkable that, as of 2019, a 750km long section from Mtwara to Mbinga, was already sealed with bitumen and in April 2019, President John Pombe Magufuli, officially flagged off the works for the upgrade of the final 67 km long section between Mbinga and Mbamba Bay.

Last section of Mbinga – Mbamba Bay Road, completed in June 2022 [Source: https://www.youtube.com/watch?v=N2n-VKF4Jx8]

It is also remarkable that so much road construction could be accomplished in the seven years (2015-22) covered by this feature, considering that at some point, work on the Tunduru to Matemanga section stopped for a while, as a contractor had to be replaced due to poor performance.

So, one can rightfully commend Government for efforts in infrastructure development, given the fact that the road section in this story is part of the all-important 820-kilometre long Mtwara Port – Mbamba Bay Road – evidently an important transport corridor in the country's southern regions – which are quite rich in many ways.

The Mtwara – Mbamba Bay Road and the Mtwara Corridor in general, have brought about much joy and socio-economic emancipation to the people of Lindi, Mtwara and Ruvuma regions, which produce crops including cashew nuts, coffee, rice, sesame seed, maize, and are rich in mineral resources including gemstones-sapphires, rubies, iron ore, coal, gypsum, uranium and copper, linking them with Mtwara Port. The road also gives the neighboring landlocked country, Malawi, an additional access to the Indian Ocean and provides access to the southern part of Selous Game Reserve, which is a major tourist attraction. Bravo to the Government and the contractors!



Sources: https://t2m.org/roads-and-travel-in-tanzania-a-reflection-on-history-current-trends/;https://en.wikipedia.org/wiki/List_of_roads_in_Tanzania]

Full Depth Reclamation: Possible remedy for rehabilitation of tarmac roads

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Where would we be without roads? Well, not far! The truth is this: it is nearly impossible to overstate the vital role roads have played and continue to play in the development of a nation. From ancient times roads have linked communities and countries, facilitating trade, communication and transport – all these are essential in development activities. However, while road construction dates back to ancient civilizations, it was in the 19th century when advancements in materials technology, such as macadam and asphalt, revolutionized it. Today, developments in these fields continue playing a vital role in developing efficient and safe road construction techniques.

Part of Tanzania's extensive road network: It is nearly impossible to overstate the vital role roads continue to play in the development of a nation
https://www.worldhighways.com/wh3/wh6/wh8/wh10/feature/tanzanias-work-east-africas-multi-national-road-project

So, in a way, we are on familiar ground. But notwithstanding technological advances, road construction often fails to meet public expectations of a good road, including longevity, smooth ride and safety for users – which calls for research into new ways of making them. Depending on design considerations, essentially but usually, a bituminous road would have four main layers, namely surface, binder, base, and sub-base, as one goes down the pavement structure. Without undermining the discussion, however, it is sufficient to say that a good road is one having a suitable foundation that utilises a stable material, that is, one that has little or no change in its volume and does not deform under repeated loads - whether the material is wet or dry.

A road section in failure mode

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However, roads do wear and all do so from the top down, and fail from the bottom up. This is another way of saying that the road base determines the service life of a road; it supports everything above it, including traffic loads. If adequate support does not exist, the road will rapidly fail.

Furthermore, unless the base is first built with the proper thickness for the traffic it must bear, and the gravel is compacted to a proper density with the ability to drain well, any pavement put on it will fail. It follows that the cost of reconstructing a failed road is much higher than doing it right the first time.

So, a road that has a poor base and poor drainage cannot be adequately improved with a top dressing of gravel or new pavement. Before doing anything to correct a road surface problem, road engineers take into consideration what is causing the problem *underneath.*

Building a sub-base during the second phase of the Arusha-Holil-i/Taveta-Voi Road. "The cost of reconstructing a failed road is much higher than doing it right the first time."
Source: https://www.worldhighways.com/wh3/wh6/wh8/wh10/-feature/tanzanias-work-east-africas-multi-national-road-project

Experts say that quite often roads fail not because of poor quality of the observable surface layer; problems can be due to poor choice of materials in the lower layers, inadequate compaction of lower layers, moisture or inadequate sub-surface drainage in the layers, or poor gradation. The problems can manifest themselves as rutting, cracking, potholes and, severe roughness and deformations – which in essence are structural in nature. The Contractor has been looking at some solutions being studied and recommended.

While available methods of addressing such problems, including applying a thin overlay of hot mix asphalt or surface dressing prove inadequate, leading to waste of materials, money, labour and time, another option that might come in the mind is excavating the pavement up to the layer that is causing the problem, getting rid of the problematic materials and starting the construction of the pavement from that layer upwards with virgin materials. However, this option is also too costly in terms of materials, money, and time – considering the excavated materials need to be transported to a different area, which has to bear the burden of this construction waste, and the fuel needed in transporting them.

In addition, sometimes the solutions are not practical to rehabilitate a badly deteriorated asphalt pavement due to the fact that cracking or other distress may have progressed to the extent that a more aggressive approach is needed.

Now, thanks to some new thinking by engineers, and the advent of modern road recycling machines, there is a technique known as Full Depth Reclamation (FDR) that can be used in such cases to rehabilitate a road, by utilizing the in-place materials of the old pavement, thereby saving money.

This feature is endeavouring to explore the technique as amply described by India's V.K. Singh, Engineer-in-Chief and Head of Department, U P Public Works Department, Lucknow; Y. K. Gupta, Chief Engineer, PWD, Lucknow, and Parvez Ahmad Khan, EE, PWD, Lucknow, in their paper cited at the bottom of this article, and that could be deployed to address the intertwined issues of premature road failure and huge cost of rehabilitating damaged road sections.

FDR is in effect a recycling method where all of the asphalt pavement section and a predetermined amount of underlying base material is treated to produce a stabilized base course. It is a cold process in which different types of additives such as asphalt emulsions and chemical agents such as calcium chloride, Portland cement, flyash and lime, are added to obtain an improved base. A relatively thin surface layer can then be used to cover up the base. The four main steps in the FDR process are pulverization, introduction of additive, compaction, and application of a surface or a wearing course. In cases where the in-place material is not sufficient to provide the desired depth or the properties (such as gradation) of the treated base, new materials, such as aggregates may be added.

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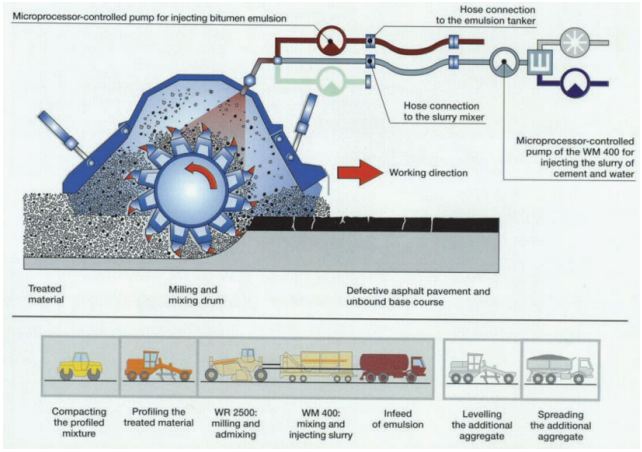
Depths of up to 300 mm can be treated with this method, although deeper layers can also be treated by milling off surface layers to an appropriate depth, if the total thickness is too high. The figures show a schematic and a typical FDR operation, with a train that consists of a recycling machine hooked to a water tanker and additive truck (foamed asphalt, for example) and steel drum roller with a pad foot shell.



Source:https://www.nbmcw.com/article-report/infrastructure-construction/roads-and-pavements/full-depth-reclamation-a-technique-for-improving-roads-with-poor-underlying-layers.html

The process can include adding chemicals to the base layer in order to increase its strength. The treatment of the base layer and recycled asphalt provides a stronger foundation for present and future traffic.

The new chemically treated base section provides engineering benefits that perform as a foundation for the new wearing surface. These benefits include higher unconfined compressive strength than the previous unbound aggregate base material, and lower permeability of the treated base which reduces the influence of water, the main reason for premature pavement failures. Stabilization of the reclaimed pavement can be done by the following mechanical, chemical, or bituminous means:

- **Mechanical Stabilization:** includes the addition of virgin aggregates, reclaimed asphalt pavement, or crushed Portland cement concrete
- **Chemical Stabilization:** can be accomplished with the addition of Calcium/magnesium chloride or other proprietary chemical products, lime, cement or cement kiln dust, or fly ash
- **Bituminous Stabilization:** can be accomplished with the addition of asphalt based emulsions or foamed asphalt

For increased stabilization requirements, combinations of all three can also be used.

For increased stabilization requirements, combinations of all three can also be used.

The advantages of this technique are considerable compared to remove-and-replace reconstruction. It provides the benefit of being equal or better in performance while also minimizing the consumption of fuel and natural resources. FDR treats all types of failures to the highest severity. It eliminates ruts, rough areas, and pot holes. It also eliminates transverse, longitudinal, and reflection cracking. In addition, it restores the grade contours to allow for better surface drainage.

In today's environment, planners of infrastructures would agree that the practice of "remove and replace" has become impractical from the standpoint of cost and environmental impact. There are tangible reasons to support the new thinking that has resulted into this reconstruction alternative - an in-place recycling method for reconstruction of existing flexible pavements using the existing pavement section material as the base for the new roadway-wearing surface.

FDR can be performed in place of traditional remove and replace reconstruction. FDR takes cold in-place recycling to the next level by grinding up the old pavement and using it as a stronger foundation for the new roadway. This is beneficial in cases where reconstruction is necessary in order to increase the structural capacity of the roadway due to increased vehicle traffic.

A comprehensive comparative study conducted by the Indian engineers showed a significant savings of 49% and 39% respectively, in material and cost, in comparison to conventional method of rehabilitation. In fact, the road, whose construction work was completed in May 2014, was inspection in October 2015 and was found to be in good condition, without any cracks.

Furthermore, the tests conducted on the road during the last inspection in October 2017, showed the road was still in very good condition and that the remaining life of the pavement was two to three times its design life – a remarkable endorsement on the novel method of rehabilitating roads.

Full Depth Reclamation is truly a cost-saving process which is also environmentally smart in extending the life of an asphalt surface. Indeed, it makes sense to use existing materials to create a superior road base.

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Cost-effective

This process has proven to be cost effective as it creates a long lasting pavement, creates a higher load carrying capacity and also reduces moisture susceptibility. Combine this with the cost-savings, and Full Depth Reclamation becomes an even more attractive alternative to completely removing and installing a new asphalt surface.

Environmentally friendly

Since this technique uses reclaimed material, it has less of an impact on the environment. Instead of having to dig up and remove the old asphalt surface before installing a new one, FDR pulverises the old surface, compacts it, and then a contractor mixes an additive that creates a stronger base for the asphalt mix.

Full Depth Reclamation offers more than just cost-savings. It helps conserve energy since there's no need to haul away or import new materials. It saves natural resources and energy since it recycles existing material and eliminates material disposal concerns, making it a much more environmentally-friendly route to take.

So, it is a very simple method: By pulverizing the existing pavement and reusing it in-place, the contractor is able to create a strong, solid foundation for the new road!

Source: https://uppwd.gov.in/site/writereaddata/siteContent/20190424200852l4297.pdf

FROM THE PRESS

Paving with plastics: a novel technique for rehabilitation of roads

Road works in which waste plastic is melted down and mixed with paving materials are becoming more common around the world. Although for now they use a niche technology, experts say the technique could become one of a diverse array of uses for discarded plastic.

First appearing in India two decades ago, plastic roads are being tested and built in several countries. India has installed over 96,000 kilometres of these roads. The technology is gaining ground in several countries including South Africa, Vietnam, Mexico and the Philippines.

A growing number of studies show that roads containing waste plastic have the potential to perform as well or better than traditional roads. They can last longer, are stronger and more durable in respect to loads and rutting, can tolerate wide temperature swings, and are more resistant to water damage, cracking, and potholes.

Jambulingam Street, Chennai, India - a tar road that has weathered a major flood, several monsoons, recurring heat waves and a steady stream of cars, trucks and auto rickshaws without showing the usual signs of wear and tear. Holding the road together is an unremarkable material: a cheap, polymer glue made from shredded waste plastic.

Polymer roads have proved to be surprisingly durable, winning support among scientists and policymakers in India as well as neighboring countries like Bhutan.

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In India, many new roads have been built since the government made it mandatory, in 2016, to add waste plastic into bituminous roads. India's plastic road technology grew out of experimentation done in 2001 by R. Vasudevan, a chemistry professor and dean at the Thiagarajar College of Engineering in Madurai. Recognizing the similarities between plastic and bitumen, he mixed shredded plastic with gravel, then bitumen, and saw a good bonding effect. Vasudevan's method employs two types of plastic: LDPE, or low-density polyethylene used in plastic bags, and PET, polyethylene terephthalate, used in soda bottles. The process was patented in 2006.

A modified version of the road which adds road scrap to plastic-coated gravel was tested out in March this year on a highway connecting Chennai with Villupuram. It was the first time plastic road technology was used for a national highway. It is expected to reduce construction costs by 50%.
Chennai was an early adopter of the technology, building its plastic roads from waste materials donated by the public. But a year later, the plan was abandoned, because the city could not produce enough shredded plastic waste. It was also rumored that influential road builders, threatened by the prospect of pothole-free roads, had scuttled the project. Later, the mayor of Chennai announced the plastic road project was being revived, triggered in part by the devastation to Chennai's roads after the floods of 2015.
The Indian government has announced that plastic roads would be the default method of construction for most city streets, part of a multibillion-dollar overhaul of the country's roads and highways. Urban areas with more than 500,000 people are now required to construct roads using waste plastic.

In Ghana, the impetus for many similar road projects underway was an ambitious plan announced by President Akufo-Addo in 2018.

An engineer inspects paving blocks made from recycled plastics in a suburb of Accra, Ghana

A road running through Accra, Ghana's capital, looks like any other blacktop but in fact the asphalt contains a slurry of used plastics — shredded and melted bags, bottles, and snack wraps. In Ghana, Nelplast mixes shredded plastic waste with sand and molds the mixture into pavement blocks.
In Australia, four companies have so far constructed hundreds of miles of plastic roads, primarily smaller local roads - mainly because the local councils are far more willing to try things that are viewed as sustainable, as opposed to government departments that oversee big highways.

While different companies are pursuing different approaches, the general idea is that waste plastic is melted and mixed with other ingredients for making road asphalt. Ordinarily, asphalt is composed of 90 to 95 percent aggregate — whether gravel, sand, or limestone — and 5 to 10 percent bitumen, the black substance extracted from crude oil that binds the aggregate together. When contractors add waste plastics — which can serve as an even stronger binding agent than bitumen — they often replace just 4 to 10 percent of the bitumen, though some methods call for much more.

Research suggests that "using waste plastic in road construction helps to improve substantially the stability, strength, fatigue life, and other desirable properties of bituminous mixes, leading to improved longevity and pavement performance.
Hundreds of kilometres of roads, driveways and parking lots in Turkey, Japan, Saudi Arabia, Dubai, Australia, New Zealand, and elsewhere have used the technology.

Asphalt with the additive TonerPlas, made from mixed soft plastics, is used to resurface a roadway in Fremantle, Western Australia

Sources: The Guardian 18 September 2018, https://e360.yale.edu/features/how-paving-with-plastic-could-make-a-dent-in-the-global-waste-problem

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