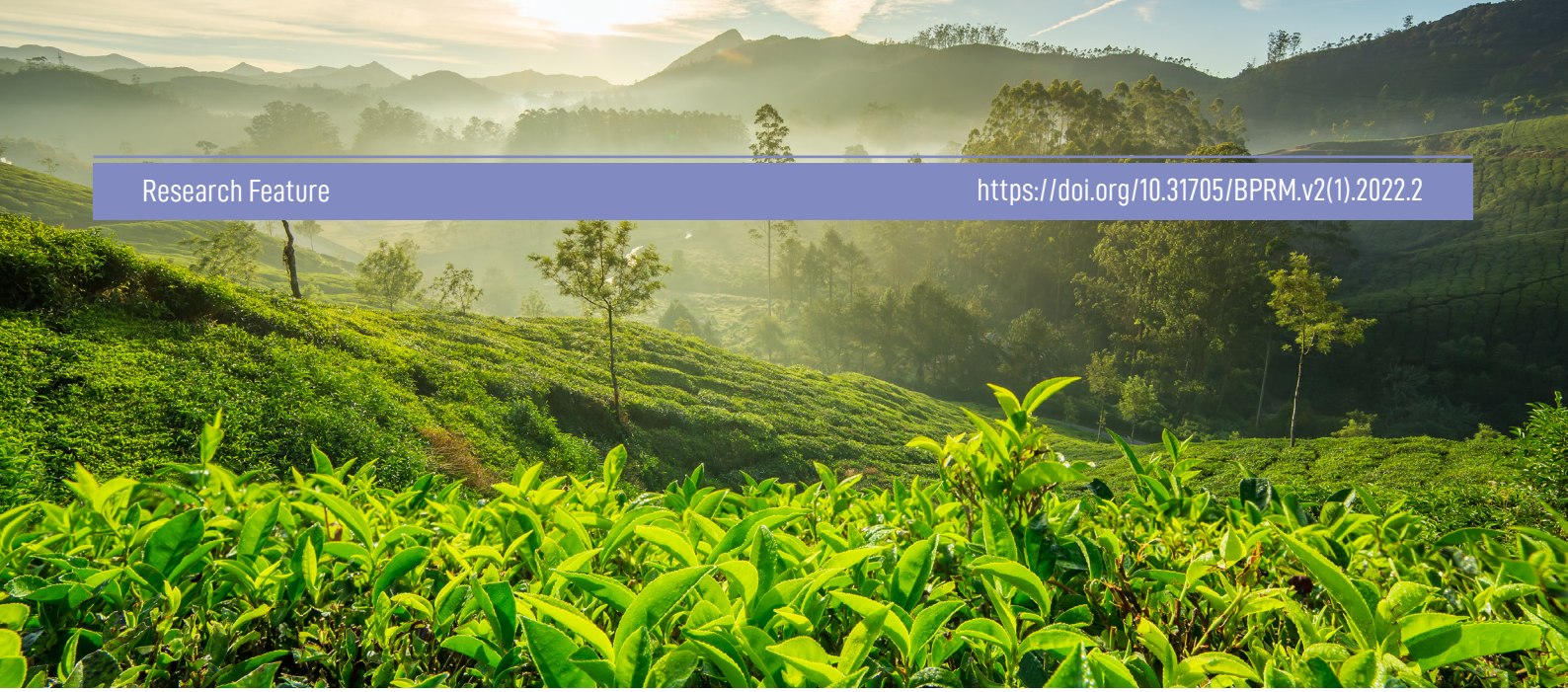

Research Feature https://doi.org/10.31705/BPRM.v2(1).2022.2

When the cool morning breeze seeps through the window, sipping a warm cup of tea breathes life into your body and heart. Yet, the tea dregs that remain are a mere afterthought miserably lying at the bottom of a waste basket. However, the dregs that we consider waste can be used to address a significant problem in the country—heavy metal contamination.

Heavy Metal Adsorption to Tea Waste

Heavy metal contamination of wastewater, specifically, in this case, copper (Cu) and lead (Pb) contamination, is an unfortunate consequence of many major industries in Sri Lanka. They include textile, metal processing, and battery manufacturing industries. Heavy metal poisoning can cause many health and environmental issues, including damage to the central nervous system and organs such as lungs, kidneys, and liver. Some methods used to remove heavy metals from water are precipitation followed by coagulation, membrane filtration, and adsorption. In coagulation and membrane filtration, disposing of the precipitated waste is a significant problem. Additionally, coagulation cannot purify water up to drinking water standards. Even though membrane filtration is effective in purification, the method is considerably expensive. Similarly, activated carbon, the most widely used for adsorption, is also quite expensive. As such, implementing these methods in Sri Lanka, where the needed technology and high initial capital are generally inaccessible, is infeasible. Thus, a cost-effective alternative is of high importance.

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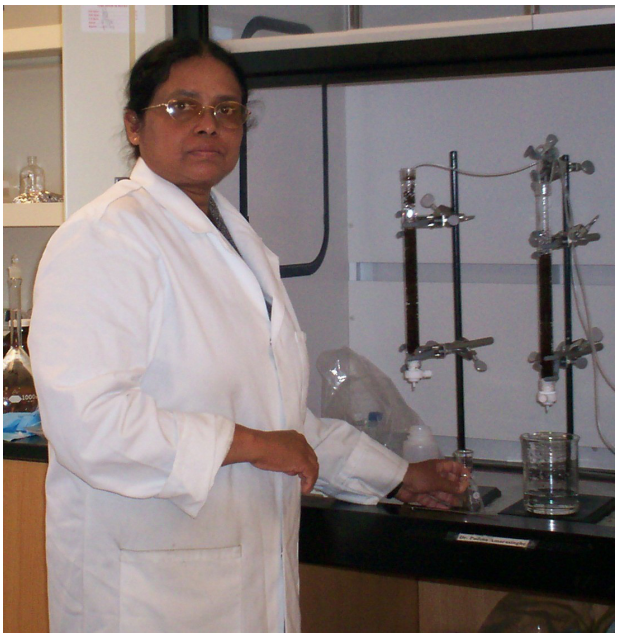

Figure 1: Prof Amarasinghe alongside packed columns used for fixed-bed adsorption tests.

Figure 2: Prof Amarasinghe and Prof Richard Williams preparing wastewater samples for adsorption tests

A cost-effective alternative is to use plant remains instead of active carbon in the adsorption process. The cellulose in plants can adsorb heavy metal cations in water. The ion exchange mechanism follows the well-known metal binding and proton-releasing reaction ($2(W\text{-}COH) + M^{2+} \rightleftharpoons (W\text{-}CO)_2M + 2H^+$).

Prof Padma Amarasinghe has taken crucial steps in implementing this method in Sri Lanka. She has researched the effectiveness of a common Sri Lankan waste product, tea waste, as an adsorbent for removing Copper and Lead from wastewater. The use of tea waste is especially suitable in the Sri Lankan context, as the disposal of tea waste has become an issue for tea manufacturers. Thus, it is generously available at a considerably low price. In her research, Prof Amarasinghe used batch adsorption tests to determine the removal rates of Cu and Pb ions with time and then repeated this for different pH levels to determine the effect of pH on adsorption. She then conducted fixed bed experiments to ascertain the practical applicability of tea waste as an adsorbent. Afterwards, she conducted isotherm experiments and experiments based on multi-component adsorption (adsorption of ions from a mixture containing) using Cu and Pb mixed ion solutions. Her results suggested that tea waste is at least as good or even better than Granular Activated Carbon, the most commonly used adsorbent commercially, in removing Cu and Pb ions from wastewater.

Figures 3. (a) & (b) show the results of the laboratory tests for adsorbing Cu ions onto granulated activated carbon and tea waste. The adsorption rate and capacity of tea leaves are similar to activated carbon at low dosages.

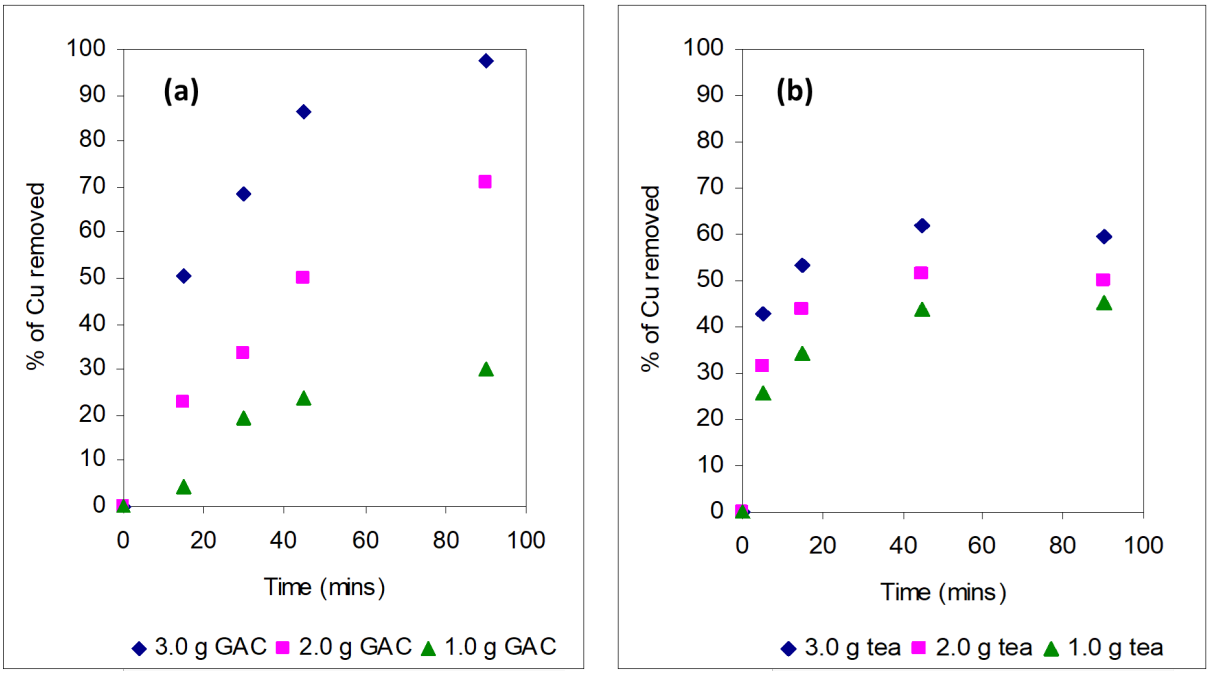

Figure 3: (a) Adsorption of Cu onto coconut shell granular activated carbon (GAC), (b) Adsorption of Cu onto tea waste

Impact of the Research

The importance of this research can be seen when looking at the number of citations received for the paper. With 1012 citations as of March 2022, the paper is the most cited paper by an academic at the University of Moratuwa. Additionally, showing its relevancy, the paper, which was first published in 2007, is still being cited. In 2021 alone, the thirteenth year after publication, the paper was cited 65 times. When asked about the impressive number of citations for her paper, the author's answer was filled with her characteristic humility and modesty. She mentioned that the number of citations was something that she had not expected. She believes the reason, however, is the research on multi-component adsorption included in the paper. In 2006, when she was conducting the study, even though there were papers on using adsorption where only one heavy metal was present, barely any had written papers regarding multi-component or binary adsorption. When searching for papers on multi-component adsorption, she could not find any at the time. As such, credit must be given to her for conducting research in such a novel yet important area.

Her Journey

The story behind Prof Amarasinghe's venture into research is also of much interest. Since her youth, she aspired to teach. Both her parents being teachers had allowed her to see the commitment and satisfaction tied to the profession. As the second female student from Maliyadeva Balika Vidyalaya, Kurunegala, to enter the Engineering faculty of the University of Moratuwa, she was, in a sense, a pioneering woman in her field. After graduation, staying true to her aspirations, she became a lecturer at the Department of Chemical and Process Engineering (DCPE) at the University of Moratuwa. She later pursued her MSc (1987) and PhD (1990) at the University of Manchester Institute of Science and Technology, England, and rejoined the DCPE, University of Moratuwa, as a Lecturer after returning to Sri Lanka. In 2005, she decided to go on sabbatical leave to pursue her research interests. At the time, the use of low-cost adsorption to remove impurities from the water was a topic that was gaining importance, but little research had been done on it.

Additionally, adsorption was an area that she taught at the University. Thus, finding the perfect topic to study, she applied to both the Commonwealth Fellowship from the UK's association of commonwealth universities and the Fulbright Fellowship from the US. As a clear sign of her preparation and commitment to the project, both the Commonwealth and Fulbright Fellowships were awarded to it. The research mentioned above was conducted through the Commonwealth Fellowship at the University of Leeds, England.

Current research – Adsorbent for antibiotics

Prof Amarasinghe is currently investigating the removal of antibiotics from wastewater, which is of much importance. Antibiotics are widely used in treating bacterial infections, such as ear and sinus infections, dental infections, skin infections, Meningitis, and Strep throat. However, some antibiotics are now less helpful due to increased antibiotic resistance. Antibiotic resistance occurs when bacteria develop the ability to defeat the drugs designed to kill them. This is a result of the overuse of antibiotics. The high prevalence of antibiotics in the environment exacerbates the emergence of antibiotic-resistant bacteria. In addition, there are no appropriate commercially available pretreatment techniques. As such, her current research is critical and timely.

Advice for Young Researchers

With more than 30 years of research, Prof Padma Amarasinghe can undoubtedly be considered a veteran in the field. Based on her experience, she imparted two golden pieces of advice for young researchers—perfect your project to the best of your ability and hone your communication skills.

To perfect a research project, one must take that extra step. When planning a project, one must research the current situation in the field, read widely in the interested area, identify research critical to the advancement of the area, and carefully choose and plan the topic. When conducting research, work hard and do proper research. Follow the correct methods when setting up experiments and performing measurements. Compare your results with already existing trusted research. All in all, regardless of your motivation, do your very best and do good research.

Even if you work very hard and do good research, it is of meagre use if you cannot communicate it. Thus, writing down a polished paper is a critical part of the research process. Some believe that using high-level English is a must when writing research papers. There is nothing further from the truth. Write using simple and concise English as it allows everyone to understand what you are presenting. This is the method preferred by the scientific audience as well. Language is not a barrier to writing a good research paper. Clarity conveys your ideas better and shows that you know your research well.

Isaac Newton said if he had seen further, it was by standing on giants. Prof Padma Amarasinghe is undeniably such a giant. We wish her the best in her research endeavours and her journey as an academic.

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