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Review Article

Arsenic and Heavy Metal Groundwater Remediation- A Far- Reaching and Insightful Review

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Abstract: Man and mankind today stands in the midst of deep scientific and engineering knowledge prowess. In the similar vision heavy metal groundwater treatment today are in the midst of deep scientific introspection. The immediate needs of the hour are engineering advancements in the field drinking water and industrial wastewater treatment. Arsenic drinking water contamination is a burning issue in developing and developed nations around the world. The author deeply reviews the vast and versatile scientific and engineering forays in the field of arsenic groundwater remediation. A newer dawn in the domain of environmental engineering will truly usher in if researchers, students, scientists and policy makers across the globe take right and positive steps in devising newer conventional and non-conventional environmental engineering tools. In the distant future, scientific research pursuit in environmental engineering science and chemical process engineering will widen human scientific thoughts and knowledge prowess in the field of arsenic groundwater remediation.

Keywords: Arsenic, drinking, water, groundwater, vision, desalination, disinfection.

1.0 INTRODUCTION

Arsenic groundwater and drinking water remediation are today in the path of newer scientific destiny and scientific and engineering provenance. Millions of people around the world are without clean drinking water and proper sanitation. The author in this article deeply elucidates newer technologies in combating global arsenic and heavy metal groundwater remediation. Application of nanotechnology, nanomaterials and engineered nanomaterials will surely open newer windows of futuristic vision, futuristic emancipation and futuristic flow of scientific thoughts. The application of United Nations Sustainable Development Goals will surely usher in a new era in global Scientific and engineering landscape. Human civilization and global science and technology are today in the newer technologies in water and wastewater treatment. In this article the author deeply investigates with grit, determination and purpose the needs of innovation and inventions in the field of chemical engineering, environmental engineering and the wide domain of nanotechnology. Scientific provenance and engineering prowess will surely usher in a newer epoch in global research and development initiatives in drinking water treatment. Scientists and engineers across the globe are today in search of newer truth and engineering innovation and vision. The motto of this article is to target the areas of difficult and robust areas of science and engineering particularly environmental engineering and science.

2.0 The Vision of This Study

The vision of this study is to re-envision and target arsenic groundwater remediation technologies. Environmental engineering science today stands in the middle of deep difficulties and scientific ardor. The challenges and ardor of science and engineering are vast and varied. Civilization and technology are today in the midst of deep Internet Revolution as well as Industrial Revolution. Heavy metal groundwater remediation are today one of the pillars of United Nations Sustainable Development Goals. The veritable aim and objective of this study is to target different scientific innovations and scientific forays in the field of drinking water treatment in developing and developed nations around the world. Scientific stewardship and scientific ingenuity in the field of arsenic groundwater and drinking water remediation along with its linkages with

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environmental sustainability will all go a long and visionary way in unveiling the truth and engineering intricacies. Surely a dawn of human civilization will unfold if policy makers and scientists across the world targets environmental and energy resources sustainability. Civilization is today in the need of scientific forbearance and scientific fortitude [1-3].

3.0 The Need and the Rationale of This Study

Today there is an immense need and rationale in the field of groundwater heavy metal and arsenic remediation. The ardor, trials and tribulations in human society and human life are vast and varied. Arsenic is a huge burden in undeveloped countries across the globe. A greater need is in the field of energy sustainability, renewable energy and environmental sustainability. Alleviation of poverty, hunger and human struggle are part and parcel of United Nations and Global Sustainable Development Goals. Human struggle and hardship are immense in underprivileged nations across the globe. The author deeply targets the needs and necessities of drinking water and groundwater treatment across the world. Human struggle in society and implementation of science and engineering are two opposite sides of the coin. Surely a newer day and a newer life in the field of water will usher in as civilization treads forward. With the march of scientific history and time, human civilization is today ensconced with immense public health engineering issues. There are extremely immense needs and rationale behind this study. This article deeply elucidates the veritable needs of United Nations Sustainable Development Goals in the futuristic emancipation of industrial wastewater treatment and drinking water treatment. Deep scientific provenance, scientific ingenuity and engineering vision will go a long and visionary way in unfurling the truth of water sustainability and water integrity [1-3].

4.0 Environmental, Energy Resources Sustainability, Renewable Energy and the Vision for the Future

Environmental and energy resources sustainability are the absolute needs and dictums of science and engineering in today's scientific and engineering landscape. Success of science, technology, engineering and medicine are the remarkable areas of sustainable development and environmental management today. The vast vision for the future in the field of water remediation and scientific integrity are in the process of scientific regeneration. Technology and engineering science are today in the middle of deep conundrums and regeneration. The author in this article deeply targets the needs of environmental sustainability and environmental stewardship in the futuristic emancipation in the field of water radiation. A newer day in human civilization is in process if science and engineering moves towards newer innovations in nanotechnology and groundwater remediation. Scientific revelation and progress of science will surely unfold and unravel a new beginning in the field of human sufferings, hardship and trials and tribulations of life. In the similar way, infrastructure and mobility should be integrated with environmental sustainability. Environmental and sustainability stewardship are the vast vision for the future in the futuristic path of human research pursuit and human civilization. The authors deeply explains and investigated the immense needs of environmental pollution control, environmental integrity and environmental management. Human civilization's immense scientific stance today stands in the crossroads of innovation and scientific and engineering innovations and vision. This article deeply reiterates the needs and necessities of Global sustainable development goals. A strong and positive scientific and engineering effort is the need of the hour. Thus futuristic science and engineering vision will surely open wider aisles in the field of environmental engineering science and water remediation [4-6].

5.0 The Scientific Doctrine, Scientific Fortitude and the Vast Scientific Ingenuity of Arsenic Groundwater Remediation

Arsenic groundwater contamination is a veritable burden of underprivileged countries across South Asia and across the globe. Scientific provenance and engineering might and capability are the needs of the path of civilization today. Heavy metal drinking water contamination is in the similar vein are in the crossroads of engineering rigmaroles. Surely one day a newer visionary era will ensue if man, mankind and science walks positively in the futuristic vision of human civilization. Today a devastating water stress is occurring in developing and developed nations around the world. The authors deeply reiterates these areas of research and development efforts. In the global scientific landscape, Global Sustainable Development Goals are of immediate concern and of deep scientific vision in the futuristic path of human civilization. Civilization, science, technology, engineering and medicine today stands in the confluence of deep scientific provenance and scientific benediction. The Fourth Industrial Revolution, sustainable development and environmental management should be intertwined with each another. In the similar vision, the Fourth Internet Civilization and environmental stewardship should be integrated to each other. Surely and veritably a newer aisle in environmental engineering science and environmental management will emerge as man and mankind moves forward [7].

6.0 Environmental Engineering Science, Technology and the Visionary Future in the Global Landscape

Today science and engineering have a truncated vision as civilization trudges forward. Humane science and engineering should be integrated with each other as a multidisciplinary effort. Man and mankind will surely witness a newer revolution and a newer regeneration if environmental management and public health engineering are interspersed with each other. The author with lucid vision and insight treads through the rugged scientific and engineering terrains of science of environmental engineering science.

Engineering science and technology are today in the midst of scientific ardor and conundrum. Human being and human society are today in the brink of an unending catastrophe. Environmental and ecological disasters are today ravaging the human planet. Economic and social resilience are the pillars of human civilization today. Man's immense scientific provenance, scientific revelation and engineering prowess will surely go a long way in unveiling of newer avenues in environmental sustainability in decades to come. The world of science and technology today stands in the middle of a dark disaster that is arsenic and heavy metal groundwater contamination. Drinking water treatment and environmental sustainability are two opposite sides of the visionary coin today. A newer scientific regeneration will emerge if human civilization and human scientific research pursuit follows and implements United Nations Sustainable Development Goals. A newer era in the field of environmental engineering and science will surely open newer and elegant areas of environmental and industrial pollution control. Water sustainability and water integrity are the visionary areas of science tomorrow. The author deeply elucidates these areas with lucid and deep insight which will go a long and visionary way in unfolding scientific intricacies and engineering vision.

7.0 Global Circular Economy, Sustainable Development and the Vast and Varied Vision for the Future

Global circular economy are the scientific vision and scientific steadfastness of today's human civilization. Man and mankind's immense knowledge and engineering prowess are today in an immense shambles. Human mankind needs to look beyond United Nations sustainable development goals which includes application of circular economy. Science and technology are today huge colossus with a vision and capability of its own. Scientific vision and scientific benediction will surely open newer eras in the field of sustainability, nanotechnology and engineering science. Without application of circular economy, civilization cannot move forward. The vision and ingenuity of the science of circular economy and environmental management will be the torchbearers towards a newer visionary epoch in the field of economic and climate resilience. The author deeply stresses and reiterates on these engineering issues and vision of circular economy. A newer road and a newer aisle in human civilization will surely usher in as civilization, science, technology and vision treads forward with positive steps. In the similar vision, the scientific stance and scientific ingenuity in the field of chemical process engineering, environmental engineering science and nanotechnology will open newer fields in research initiatives in decades to come [8-11].

8.0 Circular Economy and Environmental Sustainability in the Global Engineering Firmament and Landscape

Man, mankind and vision are in the path of newer rejuvenation as regards circular economic, economic growth and economic growth of a nation. Today underprivileged nations across the world have severe water crisis. The underdeveloped and underprivileged nations across the globe are in the midst of environmental catastrophe of arsenic drinking water contamination. United Nations Sustainable Development Goals deeply addresses these scientific and engineering issues. Time has ushered in the arsenic groundwater remediation in the futuristic vision and futuristic path of man and mankind. Mankind is faced with many scientific and engineering ardor and difficulties. Application of circular economy in a nation's progress is the need of the moment. The author deeply elucidates the recent scientific and engineering advancements in the field of circular economy. Environmental and green sustainability are the other sides of the visionary coin. Global engineering firmament and landscape today stands in the middle of deep division as global public health engineering are ravaging the human planet. Science of chemical process engineering and environmental engineering have no boundaries. Circular economy and environmental pollution control are today surpassing one engineering frontier over another. The dawn of human civilization and research pursuit in manufacturing engineering and industrial pollution control are today ushering in a new era of profound scientific thoughts.

9.0 The Utmost Needs of Environmental Management and Sustainability in the Futuristic Emancipation of Science and Engineering

Today there are utmost needs of environmental management and sustainability in the truth of human civilization. Scientific truth, scientific provenance and deep scientific and engineering understanding in the field of application of United Nations Sustainable Development Goals will veritably go a long way in unfurling the true vision of global environmental engineering research and development initiatives. Drinking water treatment and industrial wastewater treatment are also in the avenues of newer scientific rejuvenation. Without the scientific and technological vision of United Nations Sustainable Development Goals, civilization cannot move forward. The stance of engineering science of water sustainability and water integrity needs to be re-envisioned with the path of futuristic science. The authors deeply stresses these engineering and scientific issues [12-14].

10.0 Heavy Metal Groundwater Remediation and the Visionary Future of Humanity

Humanity today stands in the confluence of deep trouble, trials and tribulations. Energy resources sustainability and water and wastewater treatment needs to be integrated to each other. The dawn of human civilization is ushering in a newer era of environmental and water remediation. Environmental sustainability and water sustainability will surely go a long way in unfurling the sustainability needs of human race. The visionary future of human race and mankind are in a state of distress. The future of human race stands in the middle of deep scientific comprehension. Man, mankind and vision will veritably usher in a newer era in chemical process engineering and technology as scientists, policy makers and the

civil society moves towards zero carbon emission and carbon sequestration. Science, technology, engineering and medicine are today in the avenues of newer divination and ingenuity. The future of humanity is in a state of immense disaster as regards provision of clean drinking water and proper public health engineering. There are today immense health issues as regards arsenic drinking water contamination in developing and developed nations across the world. The visionary future of humanity is absolutely bleak with respect to proper implementation of United Nations Sustainable Development Goals. People, planet and profit are in a state of immense catastrophe.

11.0 The Necessities of Arsenic Groundwater Remediation and the Future of Human Civilization

Arsenic groundwater and drinking water remediation and water sustainability are the needs of the hour today. Millions of people in developing and developed nations across the globe are without clean drinking water. Thus the future of human civilization stands in the middle of deep scientific introspection and deep scientific triumph. There are today immense necessities of industrial and drinking water treatment. There are practically no answers to groundwater remediation of heavy metals in South Asia. This article deeply reiterates the needs of innovation, science and engineering in the futuristic vision of global environmental engineering science. Human civilization has today fallen in a deep gorge of scientific intricacies and challenges. United Nations and Global Sustainable Development Goals are today the immediate needs of the hour. Industrial wastewater treatment and drinking water treatment as well as public health engineering are today the veritable pillars of Global Sustainable Development Goals. The state of environmental engineering science and chemical process engineering are today in the midst of an unending disaster. Millions of people around the world are dying due to different health related issues due to arsenic groundwater pollution. Thus public health engineering stands in the middle of deep scientific and engineering introspection. In this article, the author deeply pronounces the veritable needs of environmental, green and water sustainability in the futuristic vision of global environmental engineering science and chemical process engineering. Innovation and discoveries in the field of groundwater remediation will surely go a long and visionary way in truly unfurling the needs and necessities of human race.

12.0 Scientific Vision, Transcendence and the Futuristic Vision of Heavy Metal Drinking Water Remediation

Scientific vision and scientific transcendence in the field of environmental engineering science are today in a state of immense catastrophe. Contamination of drinking water by heavy metals are ravaging the human planet today. People and planet today stands in the midst of an unbelievable disaster that id heavy metal groundwater contamination. In South Asia, arsenic drinking water treatment is practically destroying the human planet and human scientific landscape. Inventions and discoveries are the utmost needs of the hour. In Bangladesh and India, the status of environmental and water remediation truly in the midst of devastation as well as deep introspection. Surely a newer era in scientific research and development initiatives will emerge if scientists and policy makers takes right steps towards a carbon free civilization and carbon sequestration science and engineering era. Thus the needs of environmental sustainability will be fulfilled. Environmental integrity and water sustainability are also the ultimate needs of the hour. The author in this article deeply elucidates and revisits the scientific innovations and engineering vision in the avenues towards zero-carbon emissions. The path of human scientific endeavor in environmental remediation and sustainability are far-reaching and visionary. This article deeply elucidates these scientific and engineering problems in groundwater remediation innovations and discoveries.

13.0 Arsenic Groundwater Issues in India, Bangladesh and South Asia

Arsenic groundwater contamination in South Asia has taken monstrous proportions in today's scientific and engineering landscape. Millions of people in developing and developed nations around the world are today without clean drinking water. Scientific benediction and engineering and technological prowess will thus open a newer epoch in the field of industrial wastewater treatment and drinking water treatment. The human mankind today are in the middle of deep scientific and engineering retrospection. Thus the imminent need of a detailed study of scientific innovations of arsenic groundwater remediation. The vast vision for the future will surely be re-envisioned as civilization trudges forward. Science, technology, engineering and medicine has today no answers to the difficulties and scientific ardor of groundwater heavy metal contamination. A newer day of scientific and engineering provenance is in the process of emerging. New innovations and newer engineering forays will surely witness a newer life in the distant future. Arsenic groundwater remediation will surely witness a newer light of the day if global science and engineering moves towards positive and sound futuristic tracks. Water integrity will be immensely integrated to human civilization and human scientific research pursuit. A definite and a newer scientific divination in environmental engineering technologies will surely usher in as scientists and engineers treads forward with vast might and capability.

14.0 Circular Economy, Economic Progress and United Nations Sustainable Development Goals

Circular economy is one of the pillars of United Nations Sustainable Development Goals. Scientific provenance, revelation and scientific ingenuity are at a state of distress as regards water and wastewater treatment. Economic growth of a nation involves the proper application of United Nations Sustainable Development Goals. Circular economy, sustainability and environmental management are interspersed with each other. The science of arsenic and heavy metal groundwater remediation are huge colossus with a vision and capability of its own. Today frontiers of chemical engineering and environmental engineering needs to be surpassed with the passage of time and science. Social equity and circular

economy needs also to be re-envisioned as civilization trudges forward. Man and mankind needs to look forward as regards application of circular economy and public health engineering. The human civilization needs to look forward as regards sustainable development. Surely a remarkable era in the field of environmental engineering will evolve if scientists and civil society makes wide strides in the field of circular economy and resource efficient technologies.

15.0 The Status of Environmental Engineering, Chemical Process Engineering and Nanotechnology Research in the Global Scenario

Chemical process engineering and environmental engineering science are in the present day human scientific progress are linked by an unsevered umbilical cord. Water purification science, drinking water treatment and industrial wastewater treatment are the utmost needs of civilization today. Chemical process engineering, integrated water resource management and water purification are also aligned with each other. In this entire treatise, the author reiterates the need of chemical engineering as well as environmental engineering in arsenic groundwater remediation. Hunger, poverty and hardship are intertwined with each other in today's scientific landscape. The author reiterates the vast needs and necessities of conventional and non-conventional environmental engineering tools. A remarkable day will surely come in future when humanity and civilization joins hands in ameliorating poverty and hunger with the help of science, technology, engineering and medicine. At that situation, humanity will surely usher in a new epoch in environmental and water integrity [13-14].

16.0 Future Scientific and Engineering Prowess of This Study and the Future Flow of Scientific Thoughts

Humanity, civilization and technology are today in the middle of an unending environmental and ecological catastrophe. The futuristic vision and the vast vision for the future needs to be revamped with the progress of human civilization. Environmental science and technology today stands in the confluence of deep scientific divination and ardor. The author deeply reiterates the needs of United Nations Sustainable Development Goals and its challenges and future prospects. The futuristic vision of environmental integrity and arsenic groundwater remediation is vast, varied and visionary. Thus the author deeply suggests the needs and dictums of conventional and non-conventional environmental engineering technology. Today human civilization are in the needs of scientific providence and engineering provenance with the progress of environmental engineering and science. The authors also repeatedly pronounces the needs of energy resources sustainability and environmental sustainability in the futuristic vision of the domain of industrial pollution control. Sustainability and environmental management should be at the helm of research initiatives of researchers and policy makers across the globe. It is then scientific revelation and scientific divination will be at the zenith of humane science and engineering [13, 14].

17.0 CONCLUSION AND ENVIRONMENTAL ENGINEERING PERSPECTIVES

Human mankind and science today are in the confluence of deep scientific introspection and deep scientific conundrum. Scientific vision and scientific minimalism will surely civilization and mankind towards a newer epoch in environmental engineering science and water integrity. The author deeply pronounces these ardors of global research and development initiatives in environmental and water remediation. In the global scenario, a newer and remarkable arena in the field of nanotechnology and water treatment will emerge if science moves towards a positive and sound outlook. The environmental engineering and water technology perspective will then usher in a newer scientific genre in decades to come. Today underprivileged and disadvantaged nations across the world are beset with immense drinking water issues and water remediation issues. Public health engineering is in a state of immense distress. The vision of this article is to target these problems. A newer and vibrant era in science and engineering will surely unfold if researchers and governments across the world targets these engineering issues. Global Sustainable Development Goals are today the heart and vision of global research and development in engineering sciences. The author deeply pronounces and elucidates on the needs of application of United Nations Sustainable Development Goals in the futuristic vision of global scientific and engineering research initiatives. A newer dawn in human mankind and human civilization will surely emerge if policy makers, scientists and civil society takes positive steps in water and environmental remediation.

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