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FACULTAD DE CIENCIAS
DE LA INGENIERÍA
UNITECNAR



EXPOTECNOLOGÍA

30, 31 OCTUBRE Y 1 NOVIEMBRE 2024

22
Años

CONSTRUYENDO SOLUCIONES,
CREANDO EL FUTURO



Mayor información:
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EXPOTECNOLOGÍA

PRESENTACIÓN

La vigésima segunda edición de Expotecnología 2024 se llevó a cabo del 30 de octubre al 2 de noviembre en modalidad presencial, en la sede principal de la Fundación Universitaria Antonio de Arévalo – UNITECNAR, en la ciudad de Cartagena de Indias, Colombia. Este evento, liderado por la Facultad de Ciencias de la Ingeniería, ha sido concebido como un espacio de encuentro entre la ciencia, la tecnología y la sociedad, propiciando escenarios de divulgación académica, transferencia de conocimiento y fortalecimiento de redes de cooperación entre instituciones educativas, centros de investigación y actores del sector productivo.

Bajo el lema ***Construyendo Soluciones, Creando el Futuro***, Expotecnología 2024 reafirmó su misión de promover la innovación y la formación integral, abriendo espacios para la reflexión en torno a los desafíos contemporáneos que enfrentan las ingenierías. Las jornadas académicas y científicas contaron con la participación activa de docentes, estudiantes, egresados e investigadores nacionales e internacionales, quienes compartieron avances y resultados en diversos campos del conocimiento.

El evento se estructuró alrededor de cuatro congresos temáticos:

- Congreso Internacional de Nuevas Tecnologías
- Congreso Internacional de Petroquímica y Control de Procesos
- Congreso Internacional de Electricidad, Electrónica y Telecomunicaciones
- Congreso Internacional de Ingeniería Industrial

Cada congreso abordó temáticas de vanguardia como inteligencia artificial, machine learning, mantenimiento industrial, 5G, robótica, logística, sistemas de energía, smart grids, vehículos eléctricos, producción tecnológica y sostenibilidad energética, entre otras.

Expotecnología 2024 también contó con actividades académicas destacadas

como ponencias magistrales, jornadas pedagógicas e intercambios de movilidad, lo cual fortaleció la dimensión internacional del evento y enriqueció la experiencia de todos los participantes.

El evento fue posible gracias al trabajo conjunto del comité organizador y científico, conformado por un equipo comprometido de docentes e investigadores, quienes garantizaron la calidad académica del evento. Así mismo, se destaca la publicación de los resultados en medios de alto impacto, como la revista internacional IOP Conference Series: Materials Science and Engineering (MSE), capítulos de libro con ISBN y estas memorias que recogen los principales aportes realizados.

Con la publicación de este Libro de Memorias, la Facultad de Ciencias de la Ingeniería de UNITECNAR deja constancia del compromiso institucional con la ciencia, la tecnología, la innovación y la educación superior de calidad, proyectando a Expotecnología como un referente académico en el Caribe colombiano y el contexto internacional.

Lugar del Encuentro:

Fundación Universitaria Antonio de Arévalo

Cartagena de Indias, Colombia

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Organizado por:



Apoyado por:



OBJETIVOS

Objetivo General:

- Abordar los desafíos que emergen desde la cotidianidad de la comunidad ingenieril, y las problemáticas inmersas en el desarrollo de proyectos y programas de las IES, organizaciones y centros de investigación a nivel Nacional e Internacional.

Objetivos Específicos:

- Promover la divulgación de los trabajos de investigación de profesionales, docentes y estudiantes de todas las áreas de la ingeniería.
- Socializar temas de interés y tendencias en ingeniería, a través de presentaciones de trabajos de investigación, conferencias magistrales de expertos en el área y muestras empresariales para así estrechar los lazos entre la academia y el entorno.
- Propender por la socialización de experiencias y propuestas que constituyen potencial de desarrollo científico, tecnológico y profesional de las áreas afines a la ingeniería, como aporte a la competitividad de la región y el país.
- Mostrar los avances del sector industrial de ingeniería, como factor estratégico para el desarrollo de la región y el país, para divulgar, como la integración de tecnologías apunta a la optimización de los procesos de este sector.
- Compartir conocimientos y experiencias, fomentando el interés por mejorar y repetir las buenas prácticas en el sector de la ingeniería y profesiones afines en nuestro país.

ALCANCE

Público Objetivo:

Expotecnología 2024 estuvo dirigido a estudiantes, docentes, investigadores, egresados, empresarios, profesionales del sector productivo y miembros de la comunidad científica y académica nacional e internacional interesados en las áreas de la ingeniería, la tecnología y la innovación. El evento ofreció espacios para el intercambio de saberes, la discusión de avances científicos y tecnológicos, y la generación de redes de colaboración interdisciplinaria.

Sobre el evento:

Expotecnología 2024 se desarrolló en un entorno académico y científico orientado a la actualización profesional, la transferencia de tecnología y el intercambio de experiencias investigativas. Estas actividades se estructuraron en torno a cuatro congresos temáticos que abordan disciplinas clave donde convergen la ciencia, la academia y la sociedad, contribuyendo a la formación profesional de los asistentes, tanto a nivel nacional como internacional.

Además de los congresos principales, el evento incluyó una agenda complementaria con actividades paralelas de alto impacto académico y formativo, entre las que se destacaron:

- IX Maratón de Programación.
- VIII Torneo de Robótica
- Feria de la Ciencia y la Innovación

EJES TEMÁTICOS

La agenda del evento incluye conferencias magistrales desarrolladas por invitados nacionales e internacionales, así como ponencias programadas de manera simultánea, en las cuales participarán estudiantes, docentes y profesionales de todas las áreas de la Ingeniería. Las temáticas generales a abordar son:

XIV CONGRESO INTERNACIONAL DE NUEVAS TECNOLOGÍAS

- Artificial Intelligence
- Machine Learning
- Blockchain
- Software Engineering

VIII CONGRESO INTERNACIONAL DE PETROQUÍMICA Y CONTROL DE PROCESOS

- Materials Sciences
- Instrumentation and Control Systems
- Robotics and Automation
- Industrial Maintenance

VIII CONGRESO INTERNACIONAL DE ELECTRICIDAD, ELECTRÓNICA Y TELECOMUNICACIONES

- IoT
- Fiber Optics
- Digital Signal Processing
- Wireless Networks
- Mobile Communications
- Power Systems
- Power Electronics
- Energy Storage
- Smart Grids
- Renewable Energy

- Energy markets
- Computational Modeling
- Electrical Vehicles

III CONGRESO INTERNACIONAL DE INGENIERÍA INDUSTRIAL

- Lean Manufactory
- Production Technologies
- Logistics and Transport
- Techniques and Technologies in Supply Chains
- Integrated Management Systems

PUBLICACIONES:

Expotecnología 2024 publicó los artículos seleccionados de acuerdo al modo de participación, como Capítulo de Libro de Investigación o en el Journal IOP Conference Series: Material Science and Engineering (ISSN 1757-8981).

Para la publicación del artículo, por lo menos uno de los autores deberá presentar la ponencia y cancelar el valor de la inscripción en el modo de participación correspondiente (Si por alguna razón, ninguno de los autores puede realizar la presentación, se deberá cancelar un excedente y enviar su presentación en un video, notificando con anterioridad al comité organizador).

MODALIDAD

Presencial.

COMITÉ EDITORIAL

Libis del Carmen Valdez Cervantes

Sergio Alejandro Rojas Yantén

COMITÉ TÉCNICO

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EVENTOS EXPOTECNOLOGÍA 2024





CONFERENCISTAS INVITADOS



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EXPOTECNOLOGIA




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EXPOTECNOLOGIA




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MANUEL SABA PhD
Conferencia:
LOS DESAFÍOS DEL ASBESTO PARA LA SALUD PÚBLICA Y DEL MEDIO AMBIENTE.
Universidad de Cagliari, Italia

EXPOTECNOLOGIA




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ROBERTO GIORDANO
Decano
Conferencia:
LOS PROYECTOS UNIVERSITARIOS DE DESARROLLO TECNOLÓGICO COMO PROMOTORES DE MICRO-ECOSISTEMAS DE INNOVACIÓN SOCIAL LOCAL
Universidad Fasta, Argentina

EXPOTECNOLOGIA



Passive Solar Stills As A Sustainable Solution For Water Scarcity: A 20-Year Bibliometric Analysis Of Emerging Trends And Technologies

AUTHORS: B. E. Tarazona-Romero ^{1*}, A. C. Valenzuela-Osorio¹, J. G. Ascanio-Villabona ¹, N. Y. Castillo-Leon ¹, O. Lengerke-Pérez ¹, and A. Gonzales-Monsalve¹

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Abstract:

Increasing global water insecurity has generated a growing interest in seeking alternative solutions to improve desalination processes and mitigate this problem. Although large-scale desalination plants have been implemented in various parts of the world, their high installation and maintenance costs make them less viable for small and impoverished communities facing water scarcity. In this context, passive solar stills emerge as a sustainable and low-cost alternative. This article presents a comprehensive bibliometric analysis of passive solar distillation technologies over a 20-year period, using the Scopus database and VOSviewer software. The study analyzes trends in co-occurrence of key terms, authorship patterns, institutional contributions, geographic focus in the field. The results reveal significant advances in the optimization of passive solar still designs, especially through the use of advanced simulations, nanofluidic, and innovative configurations. The article highlights the most researched designs and provides insight into prevailing trends, identifying key areas for future research to improve the efficiency and sustainability of passive solar distillation systems.

Keywords: Passive solar stills, Solar desalination, Water scarcity, Bibliometric analysis

Analysis of the Incidence of Sunlight and Shadows in Architecture Located in a Hot-Dry Climate

AUTHORS: J. G. Ascanio-Villabona ^{1*}, B. E. Tarazona-Romero ¹, O. Lengerke-Pérez ¹, K. T. Jaimes-Quintero¹, and N. Y. Castillo-Leon ¹

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Abstract:

High temperatures cause discomfort in households. Active cooling methods consume 40% of household energy worldwide. Therefore, decreasing the energy demand for cooling and the emission of greenhouse gases is achieved by implementing passive cooling systems. In this context, the main objective of this study was to simulate the sunshine and shading effect of a house in a hot dry climate by means of a computational tool to evaluate the internal temperature and to define shading and orientation as a method of passive cooling in dwellings. This approach determines the internal temperature of a house based on the climatic behaviour and incidence of the sun. The study was divided into three phases. Firstly, on-site monitoring of the external climate data and the internal temperature is carried out, followed by the second stage, which consists of modelling and simulation of the dwelling. In this stage, we define the construction data that are initially needed to be introduced into the software and obtain the structural modelling of the case study house and simulate it in the different climatic and shading scenarios over a period of one year. Finally, the behaviour of the internal temperature obtained from the simulation of the calibrated model is analyzed and graphed. In summary, from the graphs, the indoor operating temperature of the dwelling is determined where a pattern of not less than 23°C as minimum temperature and a maximum of 35°C is presented. The trend of the values from May to May indicates an increase in outside temperature that exceeds 35°C throughout the month. In conclusion, the temperature is highly affected by shading and solar incidence, which calls for improvements in the orientation of the house.

Keywords: Shading Analysis, Passive Cooling, Building Simulation, Thermal Performance.

Integration of Information and Communication Technologies in the Transition to Higher Education in Mathematics

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Abstract:

High temperatures cause discomfort in households. Active cooling methods consume 40% of household energy worldwide. Therefore, decreasing the energy demand for cooling and the emission of greenhouse gases is achieved by implementing passive cooling systems. In this context, the main objective of this study was to simulate the sunshine and shading effect of a house in a hot dry climate by means of a computational tool to evaluate the internal temperature and to define shading and orientation as a method of passive cooling in dwellings. This approach determines the internal temperature of a house based on the climatic behaviour and incidence of the sun. The study was divided into three phases. Firstly, on-site monitoring of the external climate data and the internal temperature is carried out, followed by the second stage, which consists of modelling and simulation of the dwelling. In this stage, we define the construction data that are initially needed to be introduced into the software and obtain the structural modelling of the case study house and simulate it in the different climatic and shading scenarios over a period of one year. Finally, the behaviour of the internal temperature obtained from the simulation of the calibrated model is analyzed and graphed. In summary, from the graphs, the indoor operating temperature of the dwelling is determined where a pattern of not less than 23oC as minimum temperature and a maximum of 35oC is presented. The trend of the values from May to May indicates an increase in outside temperature that exceeds 35oC throughout the month. In conclusion, the temperature is highly affected by shading and solar incidence, which calls for improvements in the orientation of the house.

Keywords: Mathematical Pre-Knowledge, Higher Education, TIC.

Gantry Crane Prototype for Basic Control Pedagogical Education

AUTHORS: J. Zamorano-García ^{1*}, C. Márquez-Sánchez ^{2*}, D. L. Martínez-Vásquez ^{1*}, and J. Sandoval-Gutiérrez ^{1*}

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Abstract:

The gantry crane is an essential system with industrial applications and active academic research. From a mathematical point of view, the gantry crane is an under-actuated, stable, non-linear dynamical system whose linear model can help understand basic concepts of engineering control systems. This paper presents a gantry crane prototype design, construction, modeling, and control that is used to teach basic regulation strategies using only output feedback proportional control. Adequate pedagogical results have been obtained for the fundamental teaching of automatic control.

Keywords: Gantry Crane, Under-Actuated System, Proportional Control, Pedagogical Education.

Impact of Information and Communication Technologies on the Emotional Well-Being of University Students During Autonomous Study in Mathematics

AUTHORS: D. Sanabria ^{1*}, L. Rueda ², K. Rueda ^{1*}, and Y. Rueda ¹

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Abstract:

The need to incorporate improvement strategies in training processes that use ICT Information and Communication Technologies without generating high costs for Higher Education Institutions is becoming more and more frequent. Free access technological tools such as Khan Academy become an excellent option for institutions, not only because of the didactic methodology that it uses but also because of the possibility of promoting autonomous learning which in turn influences the affective domain of students. Therefore, the objective of the study was to measure the relationship between autonomous work in Khan Academy, academic performance and perception survey regarding levels of stress, anxiety and depression in university students. The study sample consisted of 93 students of the statistical subject. The results show that Khan Academy favors learning and also promotes the emotional well-being of university students.

Keywords: Autonomous Learning, Higher Education, Khan Academy, Academic Performance, Mental Health.

Corporate Social Responsibility (CSR) and the Impact Generated by the Activities of MSME in Cesar

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Abstract:

The work carried out in the department of Cesar sought to identify the programs and actions carried out by the department's MSMEs in terms of the impact of their economic activities, whether they are carrying out social and environmental actions, and whether their impacts are evaluated, measured and/or recorded. Considering that more than 90% of the companies are classified as microenterprises, which have a great impact on the economy of the department. This is a quantitative study, considering as universe the MSMEs of the department of Cesar in the year 2023, selected a random sample with 95% confidence and 5% margin of error, to conduct the study two surveys were applied on Likert scale, one on the social and one on the environmental, the results were processed using SPSS statistical software. The study found that 21% of the companies know of, apply, and register having an environmental CSR program, with 51.2% of the companies having no environmental actions. In the social area, only 9.4% of the MSMEs have actions, records, measure, and disclose them.

Keywords: CRS, MSME, Cesar, Environmental.

Developing Computational Thinking in Computer Science Careers: a Strategy Based on AI Chatbots

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Abstract:

The development of Computational Thinking (CT) is essential for problem-solving and algorithm development. However, computer science students face significant difficulties with these skills in their early years, leading to a high dropout rate. This paper first presents a diagnosis of CT development among first-semester students from various universities in Sucre, Colombia. Given the need to improve these outcomes, a new pedagogical strategy is proposed to enhance CT development, which utilizes advanced chatbots to provide real-time personalized assistance. This strategy is collaboratively developed as a pilot experience in the initial Algorithm and Programming courses of the participating institutions, aiming for students to discover the proper interaction with the chatbot through appropriate prompts to obtain correct responses. Its development includes specific prompts covering problem-solving aligned with the course plan. Three problems to be solved are presented as case studies, along with the prompts used and a critical analysis of the chatbot's responses. It is expected that the proper integration of advanced chatbots will increase student motivation and autonomy, facilitating more effective CT learning and fostering a critical attitude toward the results obtained through these tools.

Keywords: Computational Thinking, Computer Science Careers, Educational Strategy, AI Chatbots

Image Processing System for Non-Conforming Product Detection

AUTHORS: F. J. Razo-Bedolla ¹, A. J. Piña-Díaz ^{1*}, M. A. Pérez-Romero ¹,
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Abstract:

This work presents a recognition and separation system for plastic caps on a conveyor belt to automate identifying non-conforming products. The system uses a Human-Machine Interface developed in LabVIEW for processing images captured by two cameras, which are responsible for detecting caps without a proper seal. Through an electric actuator, these caps are separated from the belt. The proposal also includes a safety system that stops the belt if objects not corresponding to the system are detected. The results indicate that this development is capable of improving the efficiency of cap separation by 25% compared to the previous process, as well as offering greater traceability and consistency.

Keywords: Pattern Recognition, Artificial Vision, Human Machine Interface.

Incidence of Corrosion on the Flexural Strength of AISI-SAE 1020 Steel

AUTHORS: C. G. Cardenas-Arias ^{1,2*}, C. L. Sandoval-Rodriguez ¹, O. Lengerke-Pérez ¹,
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Abstract:

The behavior of the steel that is subjected to flexion and how is the effect of corrosion gives us a knowledge that will serve to make decisions when designing machinery. A flexural test bench is designed, which will allow to experiment and to understand the steel behavior that undergoes flexion, the tests were carried out were made with axes that had corrosion to simulate a coastal environment and was compared with an axis without corrosion. The data obtained were plotted in the stress-strain curve, when comparing these curves, it is obtained that the increase in days of corrosion decreases, it is effort to deform the specimen 8 centimeters.

Keywords: Corrosion, Flexural Strength, AISI-SAE 1020 Steel, Stress-Deflection Diagram

Generating Trajectories of a Servo-Articulated Exoskeleton by Motion Capture

AUTHORS: A. J. Piña-Díaz ¹, M. A. Pérez-Romero ^{1*}, J. Sandoval-Gutiérrez ^{2,3},
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Abstract:

Upper limb exoskeletons have properties suitable for rehabilitation. By designing one specifically for physical therapy applications, considering range of motion, strength, and the ability to adapt to the individualized therapeutic requirements of the patient, an essential advance in the field is achieved. This work proposes a system that reproduces the movement of the right upper limb on the left upper limb, using a Data Acquisition System and an ATMEGA328 Microcontroller, with the potential to be applied in the physical rehabilitation of upper limb injuries in specific movements. The servo-articulated system has two degrees of freedom, allowing flexion-extension movements of the arm and forearm.

Keywords: Servo-Articulated Mechanism, Rehabilitation, Upper Limb.

Control of Three Variable Frequency Drives Using PAC: an Experimental Study

AUTHORS: M. A. Pérez-Romero ¹, A. E. Mejía-García ^{1*}, J. Sandoval-Gutiérrez ^{2,3},
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Abstract:

This work focuses on implementing a control system for three-phase induction motors using variable frequency drives employing a Programmable Automation Controller. A test stand was designed with three workstations that allow the precise drive of the motors through a Human Machine Interface. The programming of the Programmable Automation Controller was carried out with RsLogix 5000. Its integration with a ControlNet and EtherNet/IP network made it possible to control the speed, torque, and reversing of the motors, optimizing the motion profiles of the electric actuators. Tests demonstrated the system's robustness under varying load conditions, speed control accuracy, and operational stability, which underlines the usefulness of variable frequency drives in reducing power consumption in industrial applications.

Keywords: Variable Frequency Drive, Programmable Automation Controller, ControlNet.

Evolución de la Seguridad en las Criptomonedas en el Contexto de la Computación Cuántica

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Abstract:

This paper examines the security challenges facing cryptocurrencies in the quantum era, emphasizing the vulnerabilities of traditional cryptographic systems like public-key encryption against quantum computing. It discusses potential solutions, such as post-quantum cryptography, lattice-based encryption, and exotic digital signatures (e.g., ring and blind signatures), which enhance transaction security and privacy. The paper also highlights innovations in consensus mechanisms, such as Proof of Space and Delegated Proof of Stake, which address blockchain scalability and efficiency. The importance of user education on secure practices is underscored.

Resumen:

Este artículo analiza la seguridad de las criptomonedas en la era cuántica y cómo la computación cuántica afecta la tecnología blockchain. Se ponen de manifiesto los riesgos que los ordenadores cuánticos suponen para los esquemas criptográficos tradicionales, como la criptografía de clave pública, que actualmente protege las transacciones en las redes blockchain. Algoritmos como el de Shor tienen el potencial de debilitar esta seguridad, permitiendo a los atacantes descifrar claves privadas.

Asimismo, se examinan posibles soluciones a estos retos, como la criptografía post-cuántica, que incluye enfoques basados en retículas y firmas digitales exóticas, como las firmas de anillo y las firmas ciegas, las cuales refuerzan la privacidad y seguridad en las transacciones. El estudio también investiga la evolución de los mecanismos de consenso, resaltando innovaciones como Proof of Space (PoSpace) y Delegated Proof of Stake (DPoS), que mejoran la escalabilidad y eficiencia de las redes blockchain, así como la necesidad de educar a los usuarios en prácticas seguras.

Keywords: Quantum Computing, Blockchain, Post-Quantum Cryptography, Exotic Digital Signatures, Proof of Space (PoSpace), Cryptographic Security.

Hybrid Methodologies of Meaningful Learning: An Educational Innovation in Areandina

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Abstract:

This project deals with the implementation of an innovative educational methodology based on significant changes to address the teaching and learning process from new possibilities of dynamizing encounters with students; for this purpose, the Flipped Classroom is used as a flexible and dynamic methodology to share content with students, generating innovations from the ICT scenario and promoting quality education. For the incorporation of the Hybrid Classroom, it is necessary for teachers to plan each of the sessions in the virtual classroom in advance, or which implies that the most relevant, innovative and updated content is selected so that students can previously review, comment and socialize them; so that in the face-to-face meetings with the teacher, concerns and the activities, works or projects that are destined in the LMS Moodle for the development of skills and competencies in the ICT scenario can be addressed, complying with mixed learning or B-learning. With this project, student learning, the ways in which teachers communicate and relationships with the appropriation of knowledge are being positively impacted, the model allows generating alternatives focused on meaningful and enjoyable ways of learning in the use of educational technologies, which allow a world of possibilities to emerge in the construction of knowledge from an approach based on collaborative learning.

Keywords: Flipped Classroom, Pedagogy, Didactics, Active Learning Methodologies.

Impacto Ambiental de los Polímeros Sintéticos y Estrategias para Reducir la Contaminación por Plásticos Mediante la Economía Circular

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Abstract:

This article examines the crucial role of polymers in everyday life and their environmental impact. It analyzes their molecular structure, production methods, and classification, highlighting both natural and synthetic polymers, with a focus on plastics such as polyethylene and PVC. While plastics have been essential for technological and socio-economic development, their excessive use has triggered a global environmental crisis, severely impacting ecosystems and human health. The article advocates for adopting strategies such as the circular economy and improving recycling policies to reduce plastic pollution, stressing the importance of joint efforts between society and authorities to achieve a more sustainable future.

Resumen:

En este artículo se examina el papel crucial que los polímeros desempeñan en la vida diaria y su impacto ambiental. Se analiza su estructura molecular, métodos de producción y clasificación, destacando tanto los polímeros naturales como los sintéticos, con énfasis en plásticos como el polietileno y el PVC. Aunque los plásticos han sido fundamentales para el desarrollo tecnológico y socioeconómico, su uso desmesurado ha provocado una crisis ambiental de escala global, con graves consecuencias para los ecosistemas y la salud humana. Se plantea la adopción de estrategias como la economía circular y la mejora de las políticas de reciclaje para mitigar la contaminación por plásticos, subrayando la importancia de una colaboración estrecha entre la sociedad y las autoridades para construir un futuro más sostenible.

Keywords: Polímeros, Plásticos, Contaminación Ambiental, Economía Circular, Reciclaje, Sostenibilidad, Desarrollo Tecnológico, Salud Pública