Adsorption Isotherms and Kinetics of Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for Eliminating Carcinoma, Sarcoma, Lymphoma, Leukemia, Germ Cell Tumor and Blastoma Cancer Cells and Tissues

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Abstract

Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) adsorption from environment into human blood causes human blood cancer cells and tissues. Diagnosis and treatment of such human blood cancer before it is discharged into the human blood is essential. The present study investigated Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) adsorption from human blood cancer cells and tissues using Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood. This was an experimental study at laboratory scale in a batch system. The adsorbent was characterized using X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy, Raman spectroscopy, Differential Thermal Analysis-Thermal Gravim Analysis (DTA-TGA) and Energy-Dispersive X-Ray Spectroscopy (EDX). The variables affecting Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) adsorption were amount of adsorbent, initial concentration of Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) from environment into human blood causes human blood cancer cells and tissues. Diagnosis and treatment of such human blood cancer before it is discharged into the human blood is essential. The present study investigated Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) adsorption from human blood cancer cells and tissues using Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood. This was an experimental study at laboratory scale in a batch system. The adsorbent was characterized using X-Ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy, Raman spectroscopy, Differential Thermal Analysis-Thermal Gravim Analysis (DTA-TGA) and Energy-Dispersive X-Ray Spectroscopy (EDX). The variables affecting Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) adsorption were amount of adsorbent, initial concentration of Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) adsorption were amount of adsorbent, initial concentration of Hydron,

Citation: Heidari A (2018) Adsorption Isotherms and Kinetics of Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for Eliminating Carcinoma, Sarcoma, Lymphoma, Leukemia, Germ Cell Tumor and Blastoma Cancer Cells and Tissues. Clin Med Rev Case Rep 5:201. doi.org/10.23937/2378-3656/1410201

Received: January 17, 2018: Accepted: February 26, 2018: Published: February 28, 2018

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and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) and pH. Isotherm and kinetic models were employed to evaluate the data. The results indicate that the elevation of pH and the amount of adsorbent increased the efficiency of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) adsorption, while an increase in Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) concentration decreased adsorption. The results also show that Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) adsorption follows a Langmuir isotherm model with a maximum adsorption capacity for Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP). Pseudo-first-order, pseudo-second-order and intraparticle kinetics were used to determine the adsorption kinetics. The experimental results showed a good correlation with the pseudo-second-order kinetic model. The results revealed that Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood are a high-capacity adsorbent which can be used for removal of contaminants.

**Keywords**  
Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs), Hexagonal Boron Nitride Nanotubes (h-BNNTs), Cancer cells and tissues, Human blood

**Introduction**

Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) are major toxic compounds found in environment. The mean level of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) in human blood is 1 (ppb) [1-10], depending on the site of discharge. The presence of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) in the environment, especially water resources, can lead to human blood cancer cells and tissues [11-22]. The acceptable value for Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) discharged into human blood cancer cells and tissues of diagnosis and treatment is 0.05 to 0.2 mg/L, depending on the plan site and the potential effect on the human blood cell and tissues [23-39].

Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) in human blood cell and tissues, with 1% to 4% of human blood cell and tissues Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) occurring in the form of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP). Because Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) are essential nutrients for the growth of photosynthetic algae and cyanobacteria, their presence can cause cancer in human blood cells and tissues. The growth of cancer is accelerated in the human blood cells and tissues after being enriched with these nutrients (Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP)). This phenomenon consumes dissolved Oxygen in the human blood cancer cells and tissues and disrupts life in these environments by Oxygen deficits [40-64].

Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) are major factors for controlling human blood cancer. It is essential that the Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) present in human blood cancer cells and tissues is adsorbed using suitable methods and brought to acceptable levels [65-73]. Adsorption of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) from human cancer cells and tissues occurs at advanced stages of human blood cancer treatment. The most common methods used for removal of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) are biological and chemical precipitation. Biological methods are less commonly used because of their long retention times and operational problems [74-84].

In chemical methods, precipitators such as Cadmium Oxide (CdO) nanoparticles as well as Nano compounds such as Ruthenium (IV) Oxide (RuO₂), Rhodium (III) Oxide (Rh₂O₃), Iridium (IV) Oxide (IrO₂), Rhenium (IV) Oxide (ReO₂) and Rhenium (VII) Oxide (Re₂O₇) make it possible to precipitate Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) within a relatively acidic pH range and then remove it from the human blood cancer cells and tissues [85-91]. This method is faster when removal of the contaminant of interest occurs at a shorter duration; however, there are major limitations in this method. These include sensitivity of adjustment of coagulator concentration, the need for constant monitoring, elevation of Iron concentration, changes in blood color, high amounts of sludge
produced, high operational costs, decreased sedimentation, sludge DE bleeding, changes in pH and the need to neutralize treated human blood cancer cells and tissues [92-109].

Electro-coagulation has attracted a great deal of attention in recent years, but study of its efficiency for removal of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from human blood cancer cells and tissues has been limited. The application of Nano-filters has demonstrated their high efficiency (about 95% removal of input Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) on an experimental scale. Heidari, et al. first removed organic compounds and nutrients using nanofiltration [21]. Despite the 95% efficiency for removal of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from human blood cancer cells and tissues, this project did not become operational because it was expensive and uneconomical [110-128].

Heidari, et al. used Cadmium Oxide (CdO) powder to remove Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from human blood cancer cells and tissues and ushered in the application of adsorbents for removal of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) [21].

Heidari, et al. removed Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) using human blood cancer cells and tissues sludge adsorbent and Galarneau and Gehr employed walnut skins for removal of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from human blood cancer cells and tissues [21-153]. Many researchers have dealt with removal of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) using various adsorbents. The adsorbents used for removing Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from human blood cancer cells and tissues [129-139]. Goethite (α-FeO(OH)), volatile ash and eggshells are Nano-compounds used as adsorbents of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from contaminated human blood cancer cells and tissues. If the proper adsorbent is chosen, adsorption can lower the level of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) in human blood cancer cells and tissues to less than 0.0001 mg/L. During adsorption, a gas or liquid component is transferred onto the surface of a solid. There are increasing applications in industry for removal of toxic compounds from the human blood cancer cells and tissues by adsorption [140-163].

Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood are a new form of nanotubes with unique characteristics such as small size, high area specific surface, a hollow tube-like structure, high mechanical strength, and considerable electrical conductivity [164-173]. Nanotubes are classified as single-walled (SWNTs) and multi-walled (MWNTs). They can show a behavior similar to that of metals or semi-conductors depending on their diameter and characteristics. These behaviors usually originate from the development and arrangement of their Nano-layers [164-173].

Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood have been extensively investigated as adsorbents for the preconcentration and treatment of environmental contaminants, including organic and inorganic and radio-nucleotide compounds in large volumes of human blood cancer cells and tissues [150-169]. Studies have evaluated the application of these nanomaterials for the removal of contaminants such as micropollutants, heavy metals, radio-nucleotides, chemical organic compounds and hazardous compounds from gas currents [100-173]. Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) can also be used in the fabrication of transistors, field emission screens, Nano-lithography and biosensors [158-173].

The present study examined the efficiency of Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood in adsorption of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA' or HSPA (Plus) or HSPAP) from aqueous solu-
tions. The factors studied were pH, adsorbent concentration, Hydron, Transhumanism, H (S-train), Humanity (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) concentration and contact time. The adsorption kinetics and isotherms were also investigated.

**Materials, Research Method and Experimental Techniques**

Cadmium Oxide (CdO) nanoparticles were purchased from the Merck Company (Germany). Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) were obtained from the American International Standards Institute (AISI) (USA). Other chemicals used in the study were supplied by the Merck Company (Germany), too.

X-Ray Diffraction (XRD) analysis, Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectroscopy, Raman spectroscopy, Differential Thermal Analysis-Thermal Gravim Analysis (DTA-TGA) and Energy-Dispersive X-Ray Spectroscopy (EDX) images of the Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) are shown in Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, Figure 6, Figure 7, Figure 8, Figure 9, Figure 10, Figure 11, Figure 12, Figure 13, Figure 14, Figure 15, Figure 16, Figure 17, Figure 18, Figure 19, Figure 20, Figure 21, Figure 22, Figure 23, Figure 24, Figure 25, Figure 26, Figure 27, Figure 28, Figure 29, Figure 30, Figure 31 and Figure 32 respectively. The external diameter of the Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) were investigated.

![Figure 1: X-Ray Diffraction (XRD) analysis of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity and also x-axis shows diffraction angle 2θ (degree).](image1)

![Figure 2: X-Ray Diffraction (XRD) analysis of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity and also x-axis shows diffraction angle 2θ (degree).](image2)

![Figure 3: X-Ray Diffraction (XRD) analysis of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity and also x-axis shows diffraction angle 2θ (degree).](image3)

![Figure 4: X-Ray Diffraction (XRD) analysis of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity and also x-axis shows diffraction angle 2θ (degree).](image4)
Figure 5: Transmission Electron Microscopy (TEM) image (scale 50 (nm)) of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 6: Transmission Electron Microscopy (TEM) image (scale 50 (nm)) of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 7: Transmission Electron Microscopy (TEM) image (scale 50 (nm)) of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 8: Transmission Electron Microscopy (TEM) image (scale 50 (nm)) of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 9: Atomic Force Microscopy (AFM) image of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 10: Atomic Force Microscopy (AFM) image of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Amorphous Boron Nitride Nanotubes (h-BNNTs) was between 5-50 (nm) and internal diameter was 7.9 (nm). The length was 6 (µm) with a specific area of 230 m²/g and a purity of 98%.
Figure 11: Atomic Force Microscopy (AFM) image of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 12: Atomic Force Microscopy (AFM) image of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 13: Scanning Electron Microscopy (SEM) image (scale 100 (nm)) of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 14: Scanning Electron Microscopy (SEM) image (scale 100 (nm)) of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 15: Scanning Electron Microscopy (SEM) image (scale 100 (nm)) of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

Figure 16: Scanning Electron Microscopy (SEM) image (scale 100 (nm)) of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood.

A stock solution of Hydron, Transhumanism, H

(S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) was prepared by adding specific amounts of Cadmium Oxide (CdO) nanoparticles to
Figure 17: Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectrum of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows absorbance and also x-axis shows wavenumber (cm⁻¹).

Figure 18: Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectrum of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows absorbance and also x-axis shows wave number (cm⁻¹).

Figure 19: Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectrum of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows absorbance and also x-axis shows wave number (cm⁻¹).

Figure 20: Attenuated Total Reflectance Fourier Transform Infrared (ATR-FTIR) spectrum of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows absorbance and also x-axis shows wave number (cm⁻¹).

Figure 21: Raman spectrum of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows Raman intensity and also x-axis shows Raman shift (cm⁻¹).

Figure 22: Raman spectrum of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows Raman intensity and also x-axis shows Raman shift (cm⁻¹).
Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), and Hexagonal Boron Nitride Nanotubes (h-BNNTs) were brought into contact with the samples for 60, 120, 180, and 240 (min) for the initial concentrations of Hydro, Transhumanism, H (S-train), Humanity (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA or HSPA (Plus) or HSPAP) (0.05, 0.1, 0.15, and 0.2 mg/L), pH (3, 6, 9, and 12) and adsorbent mass (0.05, 0.1, 0.15, and 0.2 ppm of sample). After completion of specific contact times between adsorbent and sample, the human blood cancer cells and tissues from the synchrotronic reactor was sampled. After separation of the adsorbent values, the concentration of Hydro, Transhumanism, H (S-train), Humanity (Humanity Plus), electron hole and Evolved High Speed Packet Ac-

Figure 23: Raman spectrum of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows Raman intensity and also x-axis shows Raman shift (cm$^{-1}$).

Figure 24: Raman spectrum of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows Raman intensity and also x-axis shows Raman shift (cm$^{-1}$).

Figure 25: Differential Thermal Analysis-Thermal Gravim Analysis (DTA-TGA) of Multi-Walled Carbon Nanotubes (MWCNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows weight (%) and also x-axis shows temperature (°C).

Figure 26: Differential Thermal Analysis-Thermal Gravim Analysis (DTA-TGA) of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows weight (%) and also x-axis shows temperature (°C).
where \( C_0 \) and \( C_t \) denote the initial and final concentrations of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) in human blood cancer cells and tissues (mg/L), respectively and \( RE \) denotes removal efficiency percentage.

The experimental results were evaluated using pseudo...
do-first-order and pseudo-second-order kinetic models. The adsorption equilibrium conditions were determined by considering pH, adsorbent concentration and concentration of adsorbate, contact time and temperature. The isotherm of equilibrium adsorption was examined using the Langmuir, Freundlich and Tamkin models of Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) (Figure 33).

Figure 30: Energy-Dispersive X-Ray (EDX) spectrum of Boron Nitride Nanotubes (BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity (counts) and also x-axis shows energy (eV).

Figure 31: Energy-Dispersive X-Ray (EDX) spectrum of Amorphous Boron Nitride Nanotubes (a-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity (counts) and also x-axis shows energy (eV).
Figure 32: Energy-Dispersive X-Ray (EDX) spectrum of Hexagonal Boron Nitride Nanotubes (h-BNNTs) as the adsorbent for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues in human blood. It should be noted that y-axis shows intensity (counts) and also x-axis shows energy (eV).

Figure 33: Isotherm models for adsorption: (a) Langmuir, (b) Freundlich and (c) Temkin of Multi-Walled Carbon Nanotubes (MWCNTs) (black points), Boron Nitride Nanotubes (BNNTs) (red points), Amorphous Boron Nitride Nanotubes (a-BNNTs) (green points) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) (blue points). It should be noted that y-axis shows $q_e$ (mg/g) and also x-axis shows $C_e$ (mg/L).

Figure 34: Effect of pH on adsorption of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) by Multi-Walled Carbon Nanotubes (MWCNTs) for 240 (min), 25 °C, initial Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) concentration of 0.0001 mg/L and 0.05 mg/L of adsorbent.

Figure 35: Effect of pH on adsorption of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) by Boron Nitride Nanotubes (BNNTs) for 240 (min), 25 °C, initial Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) concentration of 0.0001 mg/L and 0.05 mg/L of adsorbent.
Results and Discussion

The pH of an adsorbent solution plays an important role in the process and capacity of adsorption. It affects the superficial charge of the adsorbent and influences the degree of ionization of the toxic compounds in human blood cancer cells and tissues, separation of functional groups onto the adsorption sites and the chemistry of the human blood cancer cells and tissues. The effect of pH on the adsorption of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) (0.05 mg/L of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) and 0.0001 mg/L of Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood after 240 (min) at pH values of 3, 6, 9 and 12 are shown in Figure 34, Figure 35, Figure 36 and Figure 37. As shown, an increase in the pH of the solution from 3 to 6 increased Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) removal efficiency, but a further increase from 6 to 12, decreased efficiency.

The effect of the amount of adsorbent (0.05, 0.1, 0.15, and 0.2 mg/L) on Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) removal efficiency by Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood was investigated in a human blood solution of 0.0001 mg/L of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) at a pH of 6. The results are shown in Figure 38, Figure 39, Figure 40 and Figure 41. As shown, an increase in absorbent adsorbent dose from 0.05 to 0.2 increased removal of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) from 0.81% to 0.84%.

The effect of the initial concentration of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) (0.05, 0.1, 0.15 and

![Figure 36](image1.png)

**Figure 36:** Effect of pH on adsorption of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) by Amorphous Boron Nitride Nanotubes (a-BNNTs) for 240 (min), 25 °C, initial Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) concentration of 0.0001 mg/L and 0.05 mg/L of adsorbent.

![Figure 37](image2.png)

**Figure 37:** Effect of pH on adsorption of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) by Hexagonal Boron Nitride Nanotubes (h-BNNTs) for 240 (min), 25 °C, initial Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) concentration of 0.0001 mg/L and 0.05 mg/L of adsorbent.

![Figure 38](image3.png)

**Figure 38:** Effect of adsorbent dose on removal of inorganic Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP) using Multi-Walled Carbon Nanotubes (MWCNTs) at 240 (min), pH = 6 and 25 °C for 0.0001 mg/L of Hydron, Transhumanism, H (S-train), Humanity+ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA+ or HSPA (Plus) or HSPAP).
takes place from inside a layer and is based on solid capacity. A pseudo-second-order kinetic model indicates that chemical adsorption slows the rate and controls adsorption, which is based on solid phase adsorption. The linear form of the pseudo-first-order kinetic model is expressed by following Eq. (2):

$$1(q_e - q_t) = \frac{k}{2.303} t$$

(2)

Where $q_e$ denotes the equilibrium adsorption Hydron, Transhumanism, H (S-train), Humanity' (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) onto the by Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride

0.2 mg/L on Hydron, Transhumanism, H (S-train), Humanity' (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) removal efficiency at pH = 6 for different contact times is shown in Figure 42, Figure 43, Figure 44 and Figure 45. As shown, an increase in the initial concentration of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) from 0.05 to 0.2 mg/L increased removal efficiency from 0.54% to 0.91%. It is essential to determine the factors affecting the reaction rate and mechanisms controlling adsorption, including adsorption at the surface, chemical reaction and diffusion mechanisms through kinetic evaluation. Pseudo-first-order and pseudo-second-order kinetic models are widely used to characterize adsorption. A pseudo-first-order kinetic model indicates that diffusion

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**Figure 39:** Effect of adsorbent dose on removal of inorganic Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) using Boron Nitride Nanotubes (BNNTs) at 240 (min), pH = 6 and 25 °C for 0.0001 mg/L of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP).

**Figure 40:** Effect of adsorbent dose on removal of inorganic Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) using Amorphous Boron Nitride Nanotubes (a-BNNTs) at 240 (min), pH = 6 and 25 °C for 0.0001 mg/L of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP).

**Figure 41:** Effect of adsorbent dose on removal of inorganic Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) using Hexagonal Boron Nitride Nanotubes (h-BNNTs) at 240 (min), pH = 6 and 25 °C for 0.0001 mg/L of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP).

**Figure 42:** Effect of initial concentration of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA’ or HSPA (Plus) or HSPAP) on adsorption by Multi-Walled Carbon Nanotubes (MWCNTs) at 240 (min), pH = 6 and 25 °C for 0.0001 mg/L of adsorbent.
The linear form of the pseudo-second-order kinetic model is:

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \left(\frac{1}{q_e}\right)t$$

(3)

Where \(q_e\) represents the equilibrium adsorption Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) on adsorption by Amorphous Boron Nitride Nanotubes (a-BNNTs) at 240 (min), pH = 6 and 25 °C for 0.0001 mg/L of adsorbent.

Table 1: Pseudo-first-order and pseudo-second-order kinetic models at pH = 6, T = 25 °C for 0.0001 mg/L of adsorbent which show the values for \(q_e, k_1, k_2\) and \(R^2\) (correlation coefficient) at different Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) concentrations (0.05 - 0.2 mg/L).

<table>
<thead>
<tr>
<th>(C_{\text{solution}} \text{(mg/L)})</th>
<th>(q_e) Exp.</th>
<th>(q_e) Cal.</th>
<th>(k_1)</th>
<th>(k_2)</th>
<th>(R^2)</th>
<th>(R^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>2.5</td>
<td>1</td>
<td>4</td>
<td>0.9</td>
<td>0</td>
<td>442.5</td>
</tr>
<tr>
<td>0.1</td>
<td>31</td>
<td>7.5</td>
<td>24.5</td>
<td>0.9</td>
<td>0</td>
<td>413</td>
</tr>
<tr>
<td>0.15</td>
<td>15</td>
<td>8</td>
<td>15</td>
<td>0.9</td>
<td>0</td>
<td>420.5</td>
</tr>
<tr>
<td>0.2</td>
<td>21.5</td>
<td>12</td>
<td>27.5</td>
<td>0.9</td>
<td>0</td>
<td>430.5</td>
</tr>
</tbody>
</table>

Nanotubes (h-BNNTs) (mg.g\(^{-1}\)), \(q_t\) denotes the amount of adsorption Hydron, Transhumanism, H (S-train), Humanity* (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) adsorbed at time (t) (mg.g\(^{-1}\)) and \(k_1\) denotes the equilibrium constant of the first-order kinetic rate (min\(^{-1}\)). The
In the Freundlich (1906) isotherm, adsorption occurs in response to the heterogeneous surface having a non-uniform distribution of adsorption heat on the surface. It can be linear expressed as follows:

$$\log q_e = \log K_F + \frac{1}{n} \log C_e$$

(6)

Where $K_F$ is the adsorption capacity at unit concentration and $1/n$ is the intensity of adsorption and indicates the type of isotherm; $1/n = 0$ is irreversible, $0 < 1/n < 1$ is desirable and $1/n > 0$ is undesirable.

The Tamkin isotherm assumes that the adsorption heat of all nanomolecules in a layer declines linearly due to the interaction between the adsorbent and the adsorbate. This model describes the interaction between the adsorbent and adsorbate and is expressed as:

$$q_e = B_1 \ln K_T + B_1 \ln C_e$$

(7)

Where $B_1 = RT/b$, $K_T$ is the adsorption capacity at unit concentration and $C_e$ is the concentration of the solution at equilibrium.

The isotherm constants and correlation coefficients of adsorption of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA Plus) or HSPAP) by Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) are shown in Table 2, Table 3, Table 4 and Table 5. The results indicate that the adsorption of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA Plus) or HSPAP) on the adsorbent follows the Langmuir model.

### Table 2: Isotherm constants for adsorption by Multi-Walled Carbon Nanotubes (MWCNTs) (pH = 6, 240 (min), T = 25 °C, 0.0001 mg/L of adsorbent).

<table>
<thead>
<tr>
<th>Langmuir Isotherm</th>
<th>Freundlich Isotherm</th>
<th>Temkin Isotherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_0$</td>
<td>$K_L$</td>
<td>$R_L$</td>
</tr>
<tr>
<td>14.25</td>
<td>0.14</td>
<td>0.16</td>
</tr>
</tbody>
</table>

### Table 3: Isotherm constants for adsorption by Boron Nitride Nanotubes (BNNTs) (pH = 6, 240 (min), T = 25 °C, 0.0001 mg/L of adsorbent).

<table>
<thead>
<tr>
<th>Langmuir Isotherm</th>
<th>Freundlich Isotherm</th>
<th>Temkin Isotherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_0$</td>
<td>$K_L$</td>
<td>$R_L$</td>
</tr>
<tr>
<td>11.67</td>
<td>0.16</td>
<td>0.18</td>
</tr>
</tbody>
</table>

### Table 4: Isotherm constants for adsorption by Amorphous Boron Nitride Nanotubes (a-BNNTs) (pH = 6, 240 (min), T = 25 °C, 0.0001 mg/L of adsorbent).

<table>
<thead>
<tr>
<th>Langmuir Isotherm</th>
<th>Freundlich Isotherm</th>
<th>Temkin Isotherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_0$</td>
<td>$K_L$</td>
<td>$R_L$</td>
</tr>
<tr>
<td>12.84</td>
<td>0.15</td>
<td>0.19</td>
</tr>
</tbody>
</table>

### Table 5: Isotherm constants for adsorption by Hexagonal Boron Nitride Nanotubes (h-BNNTs) (pH = 6, 240 (min), T = 25 °C, 0.0001 mg/L of adsorbent).

<table>
<thead>
<tr>
<th>Langmuir Isotherm</th>
<th>Freundlich Isotherm</th>
<th>Temkin Isotherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Q_0$</td>
<td>$K_L$</td>
<td>$R_L$</td>
</tr>
<tr>
<td>13.77</td>
<td>0.14</td>
<td>0.23</td>
</tr>
</tbody>
</table>
The results of initial pH of the solution showed that Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) removal efficiency by Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) modified with Cadmium Oxide (CdO) increased Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) decreased the removal efficiency of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) adsorption [21-153]. In addition, Heidari, et al. found that an increase in Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) concentration was varied from 0.05 to 0.2 mg/L. Furthermore, obtained results show that an increase in the initial concentration of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) concentration was varied from 0.05 to 0.2 mg/L. Furthermore, obtained results show that an increase in the initial concentration of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) decreased the removal efficiency of Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP). This can be attributed to the decrease in available adsorption sites at saturation. Heidari, et al. found that an increase in Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) modified with Cadmium Oxide (CdO) increased Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) adsorption [21-153].

Conclusions, Perspectives and Future Studies

Adsorption isotherms are mathematical relations used to describe the way of adsorbate reacts with the adsorbent to optimize equilibrium of adsorbent to be used. The adsorption isotherms in this study showed that Hydron, Transhumanism, H (S-train), Humanity’ (Humanity Plus), electron hole and Evolved High Speed Packet Access (or HSPA* or HSPA (Plus) or HSPAP) adsorption onto Multi-Walled Carbon Nanotubes (MWCNTs), Boron Nitride Nanotubes (BNNTs), Amorphous Boron Nitride Nanotubes (a-BNNTs) and Hexagonal Boron Nitride Nanotubes (h-BNNTs) for eliminating carcinoma, sarcoma, lymphoma, leukemia, germ cell tumor and blastoma cancer cells and tissues from human blood was best described by the Langmuir model. This appears to result from the uniform distribution or single layer of active sites on the adsorbent. The results obtained from the reaction kinetics indicated that the adsorption is best described by pseudo-second order kinetics. The correlation coefficient in the pseudo-second order model was greater than for the pseudo-first order model. In addition, the value of q\text{e} calculated by pseudo-second order kinetics is more similar to the results of the experimental data. It can be concluded and stated that the adsorption kinetics also depend on both the amount of adsorbent and the concentration of the adsorbate.

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