

A BUFFER SOLUTION CONTAINS DISSOLVED C₆H₅NH₂

A BUFFER SOLUTION CONTAINS DISSOLVED C₆H₅NH₂: A COMPREHENSIVE EXPLORATION

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KEYWORDS: BUFFER SOLUTION CONTAINS DISSOLVED C₆H₅NH₂, ANILINE BUFFER, C₆H₅NH₂ BUFFER, WEAK BASE BUFFER, BUFFER SOLUTION pH, BUFFER CAPACITY, ANILINE CHEMISTRY, BUFFER PREPARATION, BUFFER APPLICATIONS.

PUBLISHER: SCIENTIFIC AMERICAN, A LEADING PUBLISHER OF SCIENCE AND TECHNOLOGY ARTICLES WITH A REPUTATION FOR ACCURACY AND HIGH-QUALITY CONTENT, REACHING A BROAD AUDIENCE OF SCIENTISTS, EDUCATORS, AND THE SCIENTIFICALLY CURIOUS PUBLIC.

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1. INTRODUCTION: UNDERSTANDING BUFFER SOLUTIONS AND ANILINE

A BUFFER SOLUTION IS AN AQUEOUS SOLUTION THAT RESISTS CHANGES IN pH UPON THE ADDITION OF SMALL AMOUNTS OF ACID OR BASE. THIS REMARKABLE PROPERTY STEMS FROM THE PRESENCE OF A WEAK ACID AND ITS CONJUGATE BASE (OR A WEAK BASE AND ITS CONJUGATE ACID) IN ROUGHLY EQUAL CONCENTRATIONS. WHEN A SMALL AMOUNT OF STRONG ACID OR BASE IS ADDED, THE BUFFER COMPONENTS REACT TO NEUTRALIZE THE ADDED SUBSTANCE, MINIMIZING THE CHANGE IN pH. THIS CHARACTERISTIC MAKES BUFFER SOLUTIONS INDISPENSABLE IN VARIOUS CHEMICAL, BIOLOGICAL, AND INDUSTRIAL APPLICATIONS. THIS ARTICLE FOCUSES SPECIFICALLY ON BUFFER SOLUTIONS THAT CONTAIN DISSOLVED C₆H₅NH₂, COMMONLY KNOWN AS ANILINE.

2. ANILINE (C₆H₅NH₂) AS A WEAK BASE IN BUFFER SOLUTIONS

ANILINE, A PRIMARY AROMATIC AMINE, IS A WEAK BASE. IT PARTIALLY IONIZES IN WATER, ACCEPTING A PROTON (H⁺) TO FORM ITS CONJUGATE ACID, THE ANILINIUM ION (C₆H₅NH₃⁺). THE EQUILIBRIUM REACTION CAN BE REPRESENTED AS:



THE EQUILIBRIUM CONSTANT FOR THIS REACTION IS THE BASE DISSOCIATION CONSTANT, K_B, WHICH IS RELATIVELY SMALL FOR ANILINE, INDICATING ITS WEAK BASICITY. A BUFFER SOLUTION CONTAINING DISSOLVED C₆H₅NH₂ NECESSITATES THE PRESENCE OF ITS CONJUGATE ACID, C₆H₅NH₃⁺. THIS IS TYPICALLY ACHIEVED BY ADDING A STRONG ACID, SUCH AS HYDROCHLORIC ACID (HCl), TO A SOLUTION OF ANILINE. THE HCl REACTS WITH ANILINE TO FORM ANILINIUM CHLORIDE (C₆H₅NH₃Cl), PROVIDING THE NECESSARY CONJUGATE ACID COMPONENT.

3. PREPARING A BUFFER SOLUTION CONTAINING DISSOLVED C₆H₅NH₂

THE PREPARATION OF A BUFFER SOLUTION CONTAINING DISSOLVED C₆H₅NH₂ INVOLVES CAREFULLY CONTROLLING THE RATIO OF ANILINE TO ITS CONJUGATE ACID. THE HENDERSON-HASSELBALCH EQUATION IS A CRUCIAL TOOL FOR CALCULATING THE pH OF A BUFFER SOLUTION AND DETERMINING THE NECESSARY AMOUNTS OF ANILINE AND ANILINIUM SALT:

$$\text{pH} = \text{pK}_\text{A} + \log\left(\frac{[\text{C}_6\text{H}_5\text{NH}_3^+]}{[\text{C}_6\text{H}_5\text{NH}_2]}\right)$$

WHERE:

pH IS THE DESIRED pH OF THE BUFFER SOLUTION

pK_a IS THE NEGATIVE LOGARITHM OF THE ACID DISSOCIATION CONSTANT (K_a) OF THE CONJUGATE ACID (ANILINIUM ION). THE pK_a CAN BE DERIVED FROM THE K_b OF ANILINE USING THE RELATIONSHIP $\text{pK}_\text{a} + \text{pK}_\text{b} = 14$ AT 25°C .

$[\text{C}_6\text{H}_5\text{NH}_3^+]$ IS THE CONCENTRATION OF THE ANILINIUM ION

$[\text{C}_6\text{H}_5\text{NH}_2]$ IS THE CONCENTRATION OF ANILINE

TO PREPARE THE BUFFER, A KNOWN VOLUME OF ANILINE IS MIXED WITH A CALCULATED AMOUNT OF A STRONG ACID (E.G., HCl) TO FORM THE ANILINIUM SALT. THE pH IS THEN MEASURED AND ADJUSTED IF NECESSARY BY ADDING SMALL AMOUNTS OF ACID OR BASE. THE PRECISE AMOUNTS REQUIRED WILL DEPEND ON THE DESIRED pH AND BUFFER CAPACITY.

4. BUFFER CAPACITY AND ITS SIGNIFICANCE IN ANILINE BUFFERS

THE BUFFER CAPACITY REFERS TO THE AMOUNT OF STRONG ACID OR BASE A BUFFER SOLUTION CAN ABSORB WITHOUT A SIGNIFICANT CHANGE IN ITS pH . A BUFFER'S CAPACITY IS MAXIMIZED WHEN THE CONCENTRATIONS OF THE WEAK BASE (ANILINE) AND ITS CONJUGATE ACID (ANILINIUM ION) ARE APPROXIMATELY EQUAL. THIS IS BECAUSE, AT THIS POINT, THE BUFFER IS MOST EFFECTIVE AT NEUTRALIZING ADDED H^+ OR OH^- IONS. DEVIATING SIGNIFICANTLY FROM THIS 1:1 RATIO REDUCES THE BUFFER CAPACITY, MAKING THE SOLUTION MORE SUSCEPTIBLE TO pH CHANGES. A BUFFER SOLUTION CONTAINING DISSOLVED $\text{C}_6\text{H}_5\text{NH}_2$, THEREFORE, NEEDS TO BE CAREFULLY PREPARED TO ENSURE ADEQUATE BUFFER CAPACITY FOR ITS INTENDED APPLICATION.

5. APPLICATIONS OF BUFFER SOLUTIONS CONTAINING DISSOLVED $\text{C}_6\text{H}_5\text{NH}_2$

BUFFER SOLUTIONS CONTAINING DISSOLVED $\text{C}_6\text{H}_5\text{NH}_2$ FIND APPLICATIONS IN VARIOUS FIELDS:

ANALYTICAL CHEMISTRY: ANILINE BUFFERS CAN BE USED IN TITRATIONS AND OTHER ANALYTICAL PROCEDURES REQUIRING A STABLE pH ENVIRONMENT. THE PRECISE pH CONTROL AFFORDED BY THESE BUFFERS ENHANCES THE ACCURACY AND RELIABILITY OF ANALYTICAL MEASUREMENTS.

ORGANIC SYNTHESIS: IN CERTAIN ORGANIC REACTIONS, A SPECIFIC pH RANGE IS CRUCIAL FOR OPTIMAL REACTION YIELDS AND SELECTIVITY. A BUFFER SOLUTION CONTAINING DISSOLVED $\text{C}_6\text{H}_5\text{NH}_2$ CAN PROVIDE THE NECESSARY pH CONTROL.

BIOCHEMISTRY AND BIOLOGY: WHILE LESS COMMON THAN OTHER BUFFERS IN BIOLOGICAL SYSTEMS DUE TO ANILINE'S TOXICITY, CAREFULLY CONTROLLED EXPERIMENTS MIGHT UTILIZE ANILINE BUFFERS IN SPECIFIC SITUATIONS WHERE ITS PROPERTIES ARE ADVANTAGEOUS.

6. LIMITATIONS AND PRECAUTIONS

WHILE USEFUL, BUFFER SOLUTIONS CONTAINING DISSOLVED $\text{C}_6\text{H}_5\text{NH}_2$ HAVE LIMITATIONS:

TOXICITY: ANILINE IS A TOXIC SUBSTANCE, POSING A HEALTH RISK IF HANDLED IMPROPERLY. APPROPRIATE SAFETY PRECAUTIONS, INCLUDING PERSONAL PROTECTIVE EQUIPMENT (PPE) AND CAREFUL WASTE DISPOSAL, ARE ESSENTIAL WHEN WORKING WITH ANILINE BUFFERS.

LIMITED pH RANGE: THE EFFECTIVE pH RANGE OF AN ANILINE BUFFER IS RESTRICTED BY THE pK_a OF THE ANILINIUM ION. OUTSIDE THIS RANGE, THE BUFFER'S CAPACITY TO RESIST pH CHANGES DIMINISHES SIGNIFICANTLY.

AIR SENSITIVITY: ANILINE CAN REACT WITH ATMOSPHERIC OXYGEN, LEADING TO DEGRADATION OVER TIME. THIS NECESSITATES CAREFUL STORAGE AND HANDLING TO MAINTAIN THE INTEGRITY OF THE BUFFER SOLUTION.

7. ADVANCED CONSIDERATIONS: TEMPERATURE AND IONIC STRENGTH

THE pH OF A BUFFER SOLUTION CONTAINING DISSOLVED $\text{C}_6\text{H}_5\text{NH}_2$ IS INFLUENCED BY TEMPERATURE AND IONIC STRENGTH. INCREASED TEMPERATURE TYPICALLY ALTERS THE EQUILIBRIUM CONSTANTS, IMPACTING THE BUFFER'S pH . SIMILARLY, VARIATIONS IN IONIC STRENGTH CAN AFFECT THE ACTIVITY COEFFICIENTS OF THE BUFFER COMPONENTS, LEADING TO CHANGES IN THE EFFECTIVE pH . THESE FACTORS MUST BE CONSIDERED, PARTICULARLY IN PRECISE APPLICATIONS.

8. CONCLUSION

A BUFFER SOLUTION CONTAINING DISSOLVED $C_6H_5NH_2$ OFFERS A UNIQUE TOOL FOR CONTROLLING pH IN VARIOUS CHEMICAL AND POTENTIALLY BIOLOGICAL SETTINGS. UNDERSTANDING ITS PREPARATION, LIMITATIONS, AND APPLICATIONS IS CRUCIAL FOR RESEARCHERS AND PRACTITIONERS WHO UTILIZE SUCH SOLUTIONS. THE HENDERSON-HASSELBALCH EQUATION PROVIDES THE ESSENTIAL FRAMEWORK FOR DESIGNING AND CONTROLLING THE pH OF THESE BUFFERS, ENSURING THEIR EFFECTIVENESS IN MAINTAINING A STABLE pH ENVIRONMENT. HOWEVER, THE TOXICITY OF ANILINE NECESSITATES CAREFUL HANDLING AND ADHERENCE TO SAFETY PROTOCOLS. THE BALANCE BETWEEN THE BENEFITS AND RISKS MUST BE CAREFULLY WEIGHED BEFORE EMPLOYING ANILINE-BASED BUFFER SOLUTIONS.

FAQs

1. WHAT IS THE pK_A OF ANILINIUM ION? THE pK_A OF THE ANILINIUM ION ($C_6H_5NH_3^+$) IS APPROXIMATELY 4.6.
1. HOW DOES THE CONCENTRATION OF ANILINE AFFECT BUFFER CAPACITY? HIGHER CONCENTRATIONS OF BOTH ANILINE AND ITS CONJUGATE ACID GENERALLY LEAD TO A HIGHER BUFFER CAPACITY.
1. CAN I USE OTHER ACIDS BESIDES HCl TO PREPARE AN ANILINE BUFFER? YES, OTHER STRONG ACIDS, SUCH AS SULFURIC ACID (H_2SO_4) OR NITRIC ACID (HNO_3), CAN BE USED, BUT THE CALCULATIONS FOR THE REQUIRED AMOUNT WILL DIFFER SLIGHTLY.
1. HOW IS THE pH OF AN ANILINE BUFFER MEASURED? THE pH CAN BE MEASURED USING A CALIBRATED pH METER.
1. WHAT ARE THE SAFETY PRECAUTIONS WHEN WORKING WITH ANILINE? WEAR APPROPRIATE PPE, INCLUDING GLOVES, EYE PROTECTION, AND A LAB COAT. WORK IN A WELL-VENTILATED AREA AND DISPOSE OF WASTE ACCORDING TO SAFETY REGULATIONS.
1. HOW STABLE IS AN ANILINE BUFFER OVER TIME? ANILINE BUFFERS ARE SUSCEPTIBLE TO DEGRADATION DUE TO OXIDATION. STORAGE IN A COOL, DARK PLACE UNDER AN INERT ATMOSPHERE CAN PROLONG THEIR STABILITY.
1. WHAT ARE THE ALTERNATIVES TO ANILINE BUFFERS? MANY OTHER BUFFERS EXIST, SUCH AS PHOSPHATE BUFFERS, ACETATE BUFFERS, AND TRIS BUFFERS, EACH WITH ITS OWN ADVANTAGES AND DISADVANTAGES.
1. CAN AN ANILINE BUFFER BE USED IN BIOLOGICAL SYSTEMS? DUE TO ITS TOXICITY, THE USE OF ANILINE BUFFERS IN BIOLOGICAL SYSTEMS IS GENERALLY DISCOURAGED. ALTERNATIVES ARE PREFERRED.

1. How can I calculate the required amount of HCl to prepare a specific aniline buffer? Use the Henderson-Hasselbalch equation and the desired pH and concentrations to calculate the required amount of HCl.

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chapters are devoted to a new perspective of contaminant geochemistry, namely irreversible changes in pristine land and subsurface systems following chemical contamination. Two chapters were added on this topic, focusing attention on the impact of chemical contaminants on the matrix and properties of both liquid and solid phases of soil and subsurface domains. Contaminant impacts on irreversible changes occurring in groundwater are discussed and their irreversible changes on the porous medium solid phase are surveyed. In contrast to the geological time scale controlling natural changes of porous media liquid and solid phases, the time scale associated with chemical pollutant induced changes is far shorter and extends over a "human lifetime scale".

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HERE, THE BUFFER ARRAY IS USED TO STORE THE DATA READ BY READ

THERE ARE MORE COMPLICATED BUFFER ...

THE BUFFER IN THIS CASE IS A SUB-STRING, STARTING AT POSITION

A BUFFER, IMPLEMENTED AS AN ARRAY OF SIZE N, OF WHATEVER TYPE

JAN 11, 2013 · AS BUFFER: AS OBJECT: { TYPE: 'MODULE' } AS STRING

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HERE, THE BUFFER ARRAY IS USED TO STORE THE DATA READ BY READ(2

THERE ARE MORE COMPLICATED BUFFER SCHEMES USED, FOR EXAMPLE A CIRCULAR BUFFER, ...

THE BUFFER IN THIS CASE IS A SUB-STRING, STARTING AT POSITIO

A BUFFER, IMPLEMENTED AS AN ARRAY OF SIZE N, OF WHATEVER TYPE YOU

JAN 11, 2013 · AS BUFFER: AS OBJECT: { TYPE: 'MODULE' } AS STRING

ANSWER

JUL 10, 2018 • SO IF YOU DEFINE YOUR POINT AS $P = [Y, X]$ THEN YOU CAN C

MINUTES WHICH ARE APPROXIMATELY 5 MILES: BUFFER = 0.04. THE BOUNDING BOX THEN IS EASILY ...

A BUFFER OVERFLOW IS BASICALLY WHEN A CRAFTED SECT

BOUNDS. IF AN ATTACKER CAN MANAGE TO MAKE THIS HAPPEN FROM OUTSIDE OF A PROGRAM IT ...

DEC 20, 2021 • THE BROWSER ENVIRONMENT DOES NOT SU

THIRD PARTY BUFFER PACKAGE AND POINT NODE.JS TO IT IN THE WEBPACK CONFIG. SEE HOW TO ...

ORA-06502: PL/SQL: NUMERIC OR VALUE ERROR: CHARACTER STRING ...

PL/SQL: NUMERIC OR VALUE ERROR: CHARACTER STRING BUFFER TOO SMALL. IS DUE TO THE FACT THAT YOU DECLARE A STRING TO BE OF A FIXED LENGTH (SAY 20), AND AT SOME POINT IN YOUR CODE YOU ASSIGN IT A ...

LINUX - HOW DO I INCREASE THE SCROLLBACK BUFFER IN A RUNNING SCREEN ...

MAY 28, 2017 • I USE THE SCREEN SCROLLBACK BUFFER A LOT. I OFTEN REALIZE AFTER THE FACT, THAT I SHOULD HAVE REDIRECTED THAT TO A LOG FILE RATHER THAN JUST PRINTING SOMETHING. I THEN DO CTRL-A :HARDCOPY ...

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