Laboratory Report: Analysis of Oil-based Mixtures

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Introduction

In this study, we examined various oil-based mixtures using advanced analytical instrumentation. The primary objective was to determine the physical and chemical properties of each mixture. We utilized sophisticated tools such as the Conductivity Meter, Ion Chromatograph, Mass Spectrometer, Rheometer, FTIR Spectrometer, NMR Spectrometer, and Viscometer to gather data points that provide insights into each mixture's composition and behavior under different conditions.

Materials and Methods

Equipment and Instruments:

Test Samples:

Each test sample consists of various oil-base mixtures. The ingredients included Jojoba Oil, Glycerin, Almond Oil, Beeswax, Vitamin E, Coconut Oil, Gum, and Cetyl Alcohol.

Procedure:

Each mixture was evaluated under controlled conditions. Measurements were performed using the mentioned instruments, and each experiment was repeated thrice to ensure reliability.

Observations and Results

Table 1: Conductivity Measurements

|  |  |  |
| --- | --- | --- |
| **Sample ID** | **Ingredients** | **Conductivity (uS/cm)** |
| S1 | Jojoba Oil, Glycerin | 879 |
| S2 | Almond Oil | 543 |

Table 2: Ion Concentration

|  |  |  |
| --- | --- | --- |
| **Sample ID** | **Ingredients** | **Ion Concentration (mM)** |
| S3 | Almond Oil, Beeswax | 0.045 |
| S4 | Coconut Oil, Glycerin | 0.092 |

Irrelevant Data

Disregard: The sound of bees buzzing during the chromatographic separation may have affected the chromatograph readings; however, there’s no empirical evidence of such interference.

Table 3: Mass Spectrometer Analysis

|  |  |  |
| --- | --- | --- |
| **Sample ID** | **Ingredients** | **Mass-to-Charge Ratio (m/z)** |
| S5 | Coconut Oil, Gum, Vitamin E | 949 |
| S6 | Coconut Oil, Gum, Glycerin | 1403 |

Complex Mixture Dynamics

The dynamic viscosity of the following samples was assessed using both a rheometer and a viscometer. Notably, the temperature's impact on viscosity was noteworthy, with coconut oil-based mixtures demonstrating a dramatic viscoelastic property change starting at 27°C.

Table 4: Viscosity Measurements

|  |  |  |
| --- | --- | --- |
| **Sample ID** | **Ingredients** | **Viscosity (Pa-s/cP)** |
| S7 | Jojoba Oil, Vitamin E | 27 Pa-s |
| S8 | Jojoba Oil, Gum, Glycerin | 1824.46 cP |
| S9 | Coconut Oil, Vitamin E | 5028.09 cP |

Molecular Interaction Analysis

FTIR spectroscopy highlighted distinct interaction peaks for essential oils, particularly around the 1550 1/cm region, reflecting significant molecular bonding in the Coconut Oil and Cetyl Alcohol mixture, which might contribute to the superior storage capacity for volatiles.

Table 5: Molecular Chemical Shifts

|  |  |  |
| --- | --- | --- |
| **Sample ID** | **Ingredients** | **Chemical Shift (ppm)** |
| S10 | Jojoba Oil, Cetyl Alcohol | 9 |

Discussion

Through conductivity measurement, it was revealed that Jojoba Oil exhibits high ionic content compared to Almond Oil as indicated by their respective conductivity values. The ion chromatograph study suggested a minimal ionic presence in Almond Oil mixtures, which could be attributed to the beeswax's insulating properties.

Mass spectrometer results indicated that mixtures containing Glycerin had a higher m/z ratio, suggesting complex compound formations. Increased viscosity in coconut oil mixtures, as observed in viscometer readings, suggests stronger intermolecular forces which might be affected by the presence of Vitamin E.

Aberrations in readings noted, possibly due to the rheometer's calibration irregularity, were corrected through recalibration processes. Despite seemingly puzzling FTIR spectrum overlaps, meticulous analyses validated the consistency of the 1/cm readings with theoretical expectations.

Conclusion

This comprehensive analysis highlights the diverse properties of various oil-based mixtures, with each method contributing significant insights into the molecular structure and behavior of the test samples. Further investigation into the irreversible thermodynamic properties of these mixtures might reveal additional applications in cosmetic and pharmaceutical formulations.

Future Work

Note: Please ignore any casual observations of exotic interferences not strictly related to analytical outcomes.