



THE REPUBLIC OF INDONESIA DEFENSE UNIVERSITY

**OPTIMIZATION OF NITROGEN CONTENT IN NITROCELLULOSE
FROM SUGARCANE BAGASSE WASTE (*Saccharum
officinarum* sp.) THROUGH VARIATIONS IN THE
RATIO OF SULFURIC ACID AND NITRIC
ACID AS NITRATING ACID MIXTURE**

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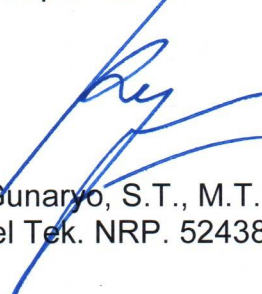
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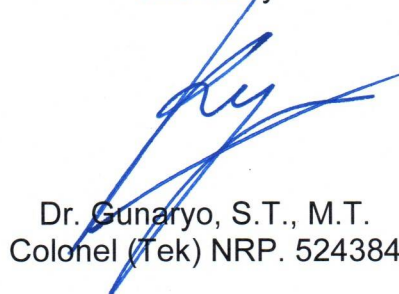


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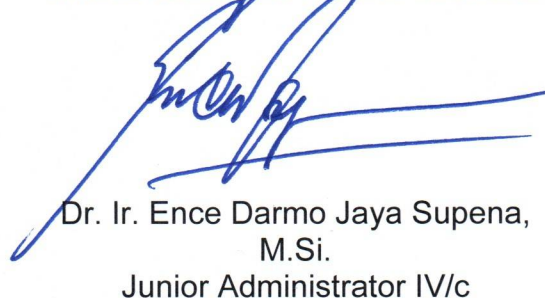
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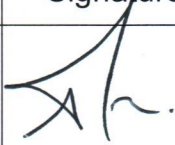
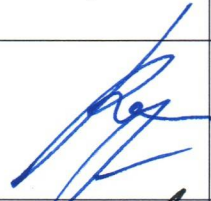
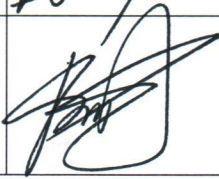


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PREFACE

With gratitude to the Almighty God for His unstoppable blessing, mercy, and grace, I have completed my undergraduate thesis titled "Optimization of Nitrogen Levels in Nitrocellulose from Bagasse (*Saccharum officinarum* sp.) Through the Variation of the Ratio of Sulfuric Acid and Nitric Acid as a Nitrating Acid Mixture". This undergraduate thesis completion fulfill one of the requirement for obtaining a Bachelor's degree at the Chemistry Study Program, Faculty of Mathematics and Natural Sciences, Republic of Indonesia Defense University.

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However, I realized that this undergraduate thesis is imperfect and I humbly expect constructive criticism and suggestions for its improvement. Finally, this thesis aims to contribute to the advancement of scientific knowledge and offer practical value to stakeholders working to enhance and optimize modern national defense technology.

Bogor, March 2025

Astrid Blandina Cynthia Lubis

ABSTRACT

OPTIMIZATION OF NITROGEN CONTENT IN NITROCELLULOSE FROM SUGARCANE BAGASSE WASTE (*Saccharum officinarum* sp.) THROUGH VARIATIONS IN THE RATIO OF SULFURIC ACID AND NITRIC ACID AS NITRATING ACID MIXTURE

Nitrocellulose is a chemical compound produced from the nitration reaction of cellulose with a mixture of nitric acid and sulfuric acid, which has strategic value as the main ingredient of propellant. This research aims to optimize the nitrogen content in nitrocellulose made from sugarcane bagasse (*Saccharum officinarum* sp.) through variations in the ratio of sulfuric acid and nitric acid as nitrating acids. The research process involved alpha-cellulose purification, nitrocellulose synthesis, and product characterization using ATR-IR spectroscopy and nitrogen content test. The purity of bagasse alpha-cellulose obtained in this study was 85.02%. The variation of titrating acid ratio (25:75, 50:50, 75:25) showed that the 50:50 ratio produced the highest nitrogen content, indicating the importance of balance between nitric acid as a nitrating agent and sulfuric acid as a catalyst and dehydrating agent. The nitrogen content in nitrocellulose with an acid ratio of 50:50 is 11.7465%. Flame test showed faster burning properties of nitrocellulose compared to pure cellulose. This research contributes to the development of local raw materials for the defense industry while offering an environmentally friendly solution for agricultural waste management.

Keywords: alpha-cellulose, nitrating acid ratio, nitrocellulose, nitrogen content, sugarcane bagasse.

ABSTRAK

OPTIMASI KADAR NITROGEN DALAM NITROSELULOSA DARI LIMBAH AMPAS TEBU (*Saccharum officinarum* sp.) MELALUI VARIASI RASIO ASAM SULFAT DAN ASAM NITRAT SEBAGAI ASAM PENITRASI

Nitroselulosa merupakan senyawa kimia yang dihasilkan dari reaksi nitrasi selulosa dengan campuran asam nitrat dan asam sulfat, yang memiliki nilai strategis sebagai bahan utama propelan. Penelitian ini bertujuan untuk mengoptimalkan kadar nitrogen dalam nitroselulosa berbahan dasar ampas tebu (*Saccharum officinarum* sp.) melalui variasi rasio asam sulfat dan asam nitrat sebagai asam penitrasi. Proses penelitian melibatkan pemurnian alfa-selulosa, sintesis nitroselulosa, dan karakterisasi produk menggunakan spektroskopi ATR-IR dan uji kadar nitrogen. Kemurnian alfa selulosa ampas tebu yang diperoleh pada penelitian ini sebesar 85.02%. Variasi rasio asam penitrasi (25:75, 50:50, 75:25) menunjukkan bahwa rasio 50:50 menghasilkan kadar nitrogen tertinggi, menunjukkan pentingnya keseimbangan antara asam nitrat sebagai agen nitrasi dan asam sulfat sebagai katalis serta agen dehidrasi. Kadar nitrogen yang terdapat dalam nitroselulosa dengan rasio asam 50:50 sebesar 11.7465%. Uji nyala menunjukkan sifat pembakaran nitroselulosa yang lebih cepat dibandingkan selulosa murni. Penelitian ini memberikan kontribusi bagi pengembangan bahan baku lokal untuk industri pertahanan sekaligus menawarkan solusi ramah lingkungan untuk pengelolaan limbah pertanian.

Kata Kunci: ampas tebu, alfa-selulosa, kadar nitrogen, nitroselulosa, rasio asam penitrasi.



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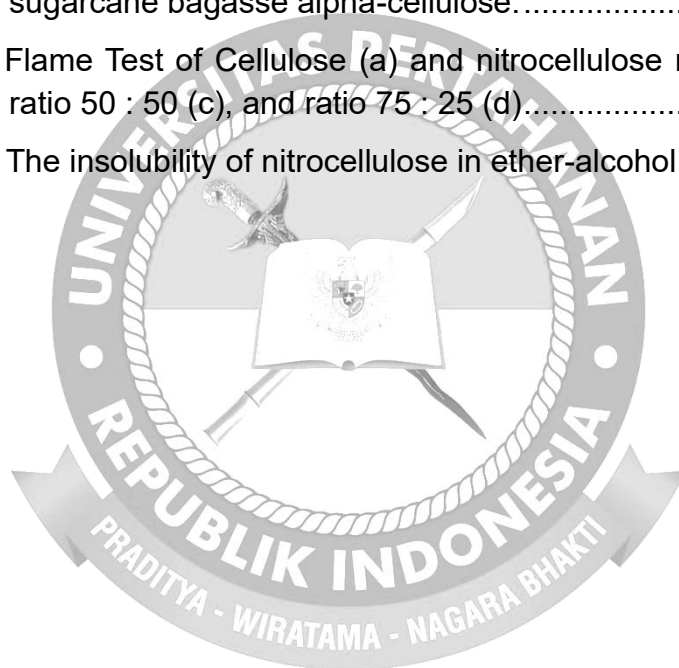
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LIST OF ABBREVIATIONS

Alutsista	: <i>Alat Utama Sistem Pertahanan</i>
TNI	: <i>Tentara Nasional Indonesia</i>
MKK	: <i>Munisi Kaliber Kecil</i>
MKB	: <i>Munisi Kaliber Besar</i>
MSG	: <i>Monosodium Glutamat</i>
CMBD	: Composite Modified Double Base
ATR-IR	: Attenuated Total Reflection Infrared
FTIR	: Fourier Transform Infrared

