DAFTAR PUSTAKA

Abdel-Shafy, H.I., dan Mansour, M.S.M., 2015, A Review On Polycyclic Aromatic Hydrocarbons: Source, Environmental Impact, Effect On Human Health And Remediation, *Egyptian Journal of Petroleum*, **25**(1): 107–123.

Achyani, R., Prartono, T., dan Riani, E., 2011, Hidrokarbon Aromatik Polisiklik dalam Air dan Sedimen Laut serta Akumulasinya pada Ikan Nomei, *Harpadon nehersu* (Hamilton, 1822) Perairan Tarakan, *Jurnal Aktiologi Indonesia*,**15**(3):267-282.

Agency for Toxic Substances and Disease Registry (ATSDR), 1995, *Public Health Statement: Polycyclic Aromatic Hidrocarbons (PAHs)*, Giorgia, Amerika Serikat.

Bohne-Kjersem, A., Skadsheim, A., Goksøyr, A., dan Grøsvik, B.E., 2009, Candidate Biomarker Discovery in Plasma of Juvenile Cod (Gadus morhua) Exposed to Crude North Sea Oil, Alkyl Phenols and Polycyclic Aromatic Hydrocarbons (PAHs), *Marine Environmental Research*, **68**(5): 268–277.

Boonyatumanond, R., Wattayakom, G., Togo, A., Takada, H., 2006, Distribution and origins of Polycyclic Aromatic Hydrocarbons in estuarine, rivers and marine sediments in Thailand, *Marine Pollution Bulletin*, **52**(9): 42- 56.

Canadian Council of Minister of the Environment, 2010, *Canadian Environmental Quality Guidelines: Canadian Soil Quality Guidelines for the Protection of Enviromental and Human Health*, Ontario, Canada.

Chen, B., Wang, Y., dan Hu, D., 2010, Biosorption and Biodegradation of Polycyclic Aromatic Hydrocarbons in Aqueous Solutions by a Consortium of White-rot Fungi, *Journal of Hazardous Materials*, **179**(1-3): 845-851.

Clement, R.E., dan Taguchi V.Y., 1989, *Techniques For The Gas Chromatography Mass Spectrometry Identification Of Organic Compounds In Effluents*, Queen's Printer for Ontario, Canada.

Culotta, L., Stefano, C..D., Gianguzza, A., Mannino, M.R., Groecchia, S., 2006, The PAH Composition of Surface Sediments from Stagnone Coastal Lagoon, Marsala (Italy), *Marine Chemistry*, **99**: 117-127.

Danish Hydraulic Institute (DHI) Water and Enviroment, 2007, *Manual Mike 21 Particle and Spill Analysis Module Scientific Background*, DHI Waters & Enviroment, Horsholm, Denmark.

Deng, W., Li, X.G., Li, S.Y., Ma, Y.Y., & Zhang, D.H., 2013, Source Apportionment of Polycyclic Aromatic Hydrocarbons in Surface Sediment

of Mud Areas in The East China Sea Using Diagnostic Ratios and Factor Analysis, *Marine Pollution Bulletin*, **70**(1–2): 266–273.

Dsikowitzky, L., Nordhaus, I., Jennerjahn, TC., Khricheva, P., Sivatharshan, Y., Yuwono, E., dan Schwarzbauer, J., 2011, Anthropogenic Organic Contaminants in Water, Sediments, and Benthic Organism, *Marine Pollution Bulletin*, **62**:851-862.

Edward, 2011, Kaji Mutu Senyawa Organik Laporan Penelitian, *Pusat Penelitian Oseanografi LIPI*, Jakarta.

Edward, 2013, Kajian Kriteria Kualitas Air Laut melalui Monitoring Tingkat Pencemaran dan Bioassay Senyawa Polisiklik Aromatik Hidrokarbon (PAH) di Teluk, *Pusat Penelitian Oseanografi LIPI*, Jakarta.

Effendi, H., 2003, *Telaah Kualitas Air*, Jurusan Managemen Sumber daya Perairan, Fakultas Perairan dan Ilmu Kelautan, IPB: Bogor.

Elias, S.M., Wood, A.K., Hashim, Z., Siong, W.B., Hamzah, M.S, Rhaman, S.A., Salim, N.A.A., dan Talib, A., 2007, Policyclic Aromatic Hydrocarbon (PAH) Contamination in The Sediments of East Coast Peninsular Malaysia, *The Malaysian Journal of Analytical Sciences*, **11**(1): 70-75.

Environmental Protection Agency (EPA), 1998, *Locating and Estimating Air Emission from Sources of Polysiclic Aromatic Matter*, United States Environmental Protection Agency, Washington DC.

Food Safety Authority of Ireland, 2015, *Polycyclic Aromatic Hydrocarbons (PAHs) in Food*, Toxicology Factsheet Series, Issue No. 2.

Gaga E.O., 2004, *Investigation of Polycyclic Aromatic Hydrocarbon (PAH) Deposition in Ankara*, The Middle East Technical University, Ankara.

Gu, Y.G., Lin, Q., Lu, T.T., Ke, C.L., Sun, R.X., dan Du, F.Y., 2013, Levels, Composition Profiles and Sources of Polycyclic Aromatic Hydrocarbons in Surface Sediments from Nan'ao Island, A Representative Mariculture Base in South China, *Marine Pollution Bulletin*, **75**(1–2): 310–316.

Guinan, J., Charlesworth, M., Service M., dan Oliver, T., 2001, Sources And Geochemical Cons-Traints Of Polycyclic Aromatic Hydrocar-Bons (Pahs) In Sediments And Mussels Of Two Northern Irish Sea-Loughs, *Marine Pollution Bulletin*, **42**(11): 1073-1081.

Guo, Y., Kusheng, W., Xia, H., Xijin, X., 2011, Sources, Distribution, and Toxicity of Polycyclic Aromatic Hidrocarbons, *Journal of Environmental Health*, **73**(9): 22-25.

Hadibarata, T., dan Kristanti, R.A., 2010, Identification of Metabolic Intermediates in Microbial Degradation of Chrysene by *Armillaria sp*. F022, *Indonesian Journal of Biotechnology*, **8**(2): 46-53.

Hasan, N.Y., 2021, Senyawa Toksik Pencemar Udara: Polycyclic Aroamtik Hydrokarbons (PAHs), *Jurnal Online Institut Teknologi Nasional*, **8**(2): 67-77.

Hermanto, 2008, *Aplikasi Alat HPTLC dan GC-MS*, Jakarta.

Heryanto, R., 2007, Hubungan antara Diagenesis, Reflektan Vitrinit dan Kematangan Batuan Pembawa Hidrokarbon Batuan Sedimen Miosen di Cekungan Bengkulu, *Jurnal Geologi Indonesia*, **2**9(2):99-111.

Hidayat, S., 2019, Analisis Senyawa Hidrokarbon Aromatik Polisiklik (HAP) dalam Teh Seduh dengan Kromatografi Gas Spektrometer Massa (GC-MS), Skripsi Tidak Diterbitkan Jurusan Kimia FMIPA, Universitas Hasanuddin, Makassar.

Hung, C.C., Gong, G.C., Chi, F., Lee, H.J., Chen, H.Y., Wua, J.M., Hsu, M.L., Peng, S.C., Nan, F.H, Santschi, P.H., 2011, Polycyclic Aromatic Hydrocarbons in Surface Sediments of the East Chine Sea and Their Relantionship with Carbonaceus Materials, *Marine Pollution Bulletin*, **63**: 464-470

Igwe, J.C., dan Ukaogo P.O., 2015, Environmental Effects of Polycyclic Aromatic Hydrocarbons, *Journal of Natural Sciences Research*, **5(**7): 117-131.

International Tanker Owners of Pollution Federation Limited (ITOPF), 2002, *Fate of Marine Oil Spill*, Technical Information, London.

Kurniawan, A., Wirasembada Y.C., Razaad I.M.N., Novriansyah, A., Rafi, M., Effendi, A.J., 2018, Hidrokarbon Aromatik Polisiklik pada Lahan Tercemar Limbah Minyak Bumi: Tinjauan Pertumbuhan Mikro-Organisme, Proses Metabolisme dan Biodegradasi, *Jurnal Ilmu Lingkungan*, **16**(1): 9-24.

La Nafie, N., Ramang, Asmawati, Ramang, M., Arief, A., 2016, Distribution of Polycyclic Aromatic Hydrocarbons in Sediments of Losari Beach and adjacent areas, South Sulawesi, Indonesia, *ISSN*, **12**(4): 675-682.

Li, Q., Wu, J., dan Zhao, Z., 2018, Spatial and Temporal Distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in Sediments from Poyang Lake, China, *Plos One*, **13**(10): 2-14.

Liang, Y., Tse, M.F., Young, L., dan Wong, M.H., 2007, Distribution Patterns of Polycyclic Aromatic Hydrocarbons (PAHs) in The Sediments and Fish at Mai Po Marshes Nature Reserve, HongKong, *Water Research*, **41**(6): 1303–1311.

Liong, S., 1995, *Kajian Kandungan Hidrokarbon n-Alkana pada Sedimen Permukaan Kawasan Pantai Barat Sulawesi Selatan sebagai Dampak Aktivitas Transportasi Kapal Laut*, Pusat Studi Lingkungan (PSL-UH), Universitas Hasanuddin.

Lithner, D., Larsson, A., dan Dave, G., 2011, Environmental and Health Hazard Ranking and Assessment of Plastic Polymers Based on Chemical Composition, *Science of the Total Environment*, **409**(18): 3309-3324.

Mangkoedihardjo, S., 2005, Seleksi Teknologi Pemulihan untuk Ekosistem Laut Tercemar Minyak, Seminar Nasional Teori & Aplikasi Teknologi Kelautan ITS Surabaya : 1-9.

Marsaoli, M., 2004, Kandungan Bahan Organik , N-Alkana, Aromatik dan Total Hidrokabon Dalam Sedimen di Perairan Raha Kabupaten Muna, Sulawesi Tenggara, *Jurnal Makara, Sains*, **8**(3): 116-122.

Melawaty, L., 2002, *Profil Hidrokarbon Aromatik Berdasarkan Kedalaman Sedimen Pantai Pulau Lumu-Lumu*, Kepulauan Spermonde, Tesis Tidak Diterbitkan,Program Pascasarjana Universitas Hasanuddin, Makassar.

Meyer, S., dan Hans, S., 2001, Fate of PAHs and Hetero-PAlls during Biodegradation in a Model Soil/Compost-System: Formation of Extractable metabolits, *Water, Air and Soil Pollution*, 132:215-231.

Mukhtasor, 2007, *Pencemaran Pesisir dan Laut*, PT Pradnya Paramita, Jakarta.

Muljana, B., 2007, Analisis Geokimia Hidrokarbon Lapangan "X" Cekungan Sumatera Selatan, *Jurnal Bulletin of Scientific Contribution*, **5**(2):111-117.

Neff, J.M., 1979, *Polycyclic Aromatic Hydrocarbon in the Aquatic Evirotment: Source, Fate ad Biological Effects*, Applied Science Plubisher, London.

Nemr, A.E., Khaled, A., EL-Sikaly, A., Said, T.O., dan Abd-Allah, A.M.A., 2005, *Distribution and Sources of Polycyclic Aromatic Hydrocarbons in Surface Sediments Of the Suez Gulf*, Environmental Divison, Natinal Institute of Oceanography and Fisheries, Egypt.

Nisa, C., Irawati, U., dan Sunardi, 2013, Model Adsorpsi Timbal (Pb) dan Seng (Zn) dalam Sistem Air-Sedimen di Waduk Riam Kanan Kalimantan Selatan, *Jurnal Konversi*, **2**(1); 7-13.

Nur, Y., Cahyotomo, A., Nanda, dan Fistoro, N., 2020, Profil GC-MS Senyawa Metabolit Sekunder dari Jahe Merah (*Zingiber officinale*) dengan Metode Ekstraksi Etil Asetetat, Etanol dan Destilasi, *Jurnal Sains dan Kesehatan*, **2**(3): 198-204.

Opuene, K., Agbozu, I. E., dan Ekeh, L. E. 2007. Identification of Perylene in Sediments: Occurance and Diagenetic Evolution. *Int. J. Environ. Sci. Tech.*, **4**(1):457-462.

Priyanto, N., Dwiyitno, dan Aryani, F., 2008, Kandungan Logam Berat Hg, PB, Cd, dan Cu pada Air, Sedimen, dan Ikan di WadukCirata Jawa Barat, *Jurnal Pascasarjana dan Bioteknologi Kelautan dan Perikanan*, **3**(1): 69-78.

Rachmawani, D., Yulianda, F., dan Kusmana, C., Boer, M., dan Parwati, E., 2016, Dampak Hidrokarbon Aromatik terhadap Ekosistem Mangrove di Kawasan Binalatung Kota Tarakan Kalimantan Utara, *Jurnal Manusia dan Lingkungan*, **23**(3): 296-303.

Rullkoten, J., dan Farrington, J.W., 2021, Assessing the Physical Properties and Chemical Composition of Petroleum and Products of Burned Oil, *Journal Oceanogrphy*, **3**(1): 45-57.

Salim, D., Yulianto, dan Baharuddin, 2017, Karakteristik Parameter Oseanografi Fisika-Kimia Perairan Pulau Kerumputan Kabupaten Kotabaru Kalimantan Selatan, *Jurnal Enggano*, **2**(2): 218-228.

Saniah, Purnawan, S., dan Karina, S. 2014, Karakteristik dan kandungan mineral pasir pantai Lhok Mee, Beureunut dan Leungah, Kabupaten Aceh Besar, *Depik Jurnal*, **3**(3):263-270.

Sumomba, T., Nafie, N.L. dan Arief, A., 2017, Analysis Of Polycyclic Aromatic Hydrocarbons (Pah) Compounds from Sediment in the Waters Kayu Bangkoa Port and Degradation of Phenanthrene in Sediment By Using $KMnO_4$ Oxidizer, *International Journal Marine Chimica Aca the Universitas Hasanuddin*, **18**(1): 1411-2132.

Wick, A.F., Haus, N.W., Sukkariyah, B.F., Haering, K.C., dan Daniels, W.L., 2011, *Remediation of PAH-Contaminated Soils and Sediments: A Literature Review,* Virginia Polytechnic Institute and State University, Blacksburg.

Widhayanti, A., Ismanto, A., Yulianto, B., 2015, Sebaran Tumpahan Minyak dengan Pendekatan Model Hidrodinamika Dan *Spill Analysis* di Perairan Cilacap, Jawa Tengah, *Jurnal Oseanografi*, **4**(4): 641-650.

Wijayaratih, Y., 2001, Perombakan Senyawa Hidrokarbon Aromatis Polisiklik (Naftalen) pada Kadar Tinggi oleh Pseudomonas NY1, *Jurnal Manusia dan Lingkungan*, 8(3): 130-141.

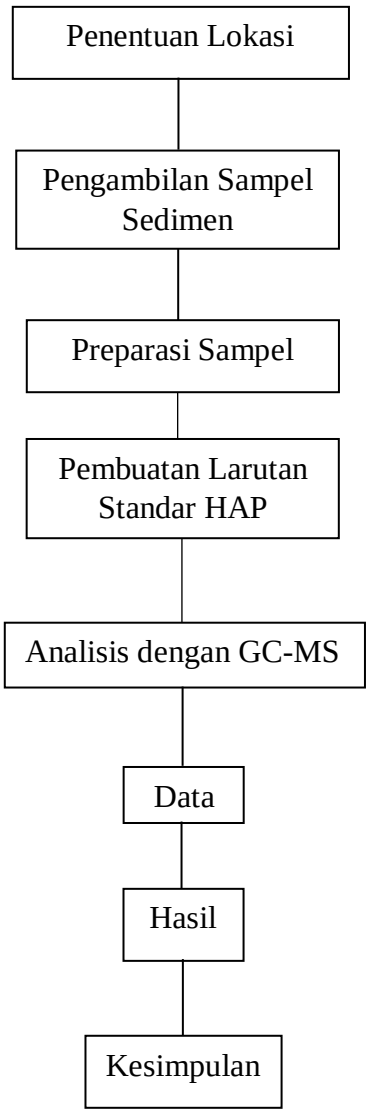
Wiyantoko, B., 2016, *Modul Kuliah Kimia Petroleum*, Kimia FMIPA, Universitas Islam Indonesia.

Wu, L., Sun, R., Li, Y., dan Sun, C., 2019, Sample Preparation and Analytical Methods for Polycyclic Aromatic Hydrocarbons in Sediment, *Trends in Environmental analytical Chemistry*, **16**(2302): 2-16.

Yogaswara, P., Wulandari, I., Khozanah, Edward, dan Falahudin, D., 2019, Distribusi Spasial, Sumber Pencemaran, dan Kajian Risiko Ekologi Polisiklik Aromatik Hidrokarbon (PAH) dalam Sedimen Pesisir di Pulau Bintan, Indonesia, *Jurnal Teknologi Lingkungan*, **20**(2): 271-279.

Zulaihah, L., 2015, Analisa Kandungan Poliaromatik Hidrokarbon pada Gas Buang Kendaraan Bermotor Berbahan Bakar Diesel, Air Laut dan Sedimen yang Terkontaminasi Tumpahan Minyak, *Jurnal Bina Teknika*, **11**(2): 131-138.

Lampiran 1. Skema Kerja Penelitian



Lampiran 2. Bagan Kerja

1. Pengambilan Sampel

Sedimen

- Diambil menggunakan *eckmen grab* sebanyak 500 g
- Dimasukkan dalam plastik sampel
- Dimasukkan dalam *cool box*
- Di bawa ke laboratorium

Sampel Sedimen

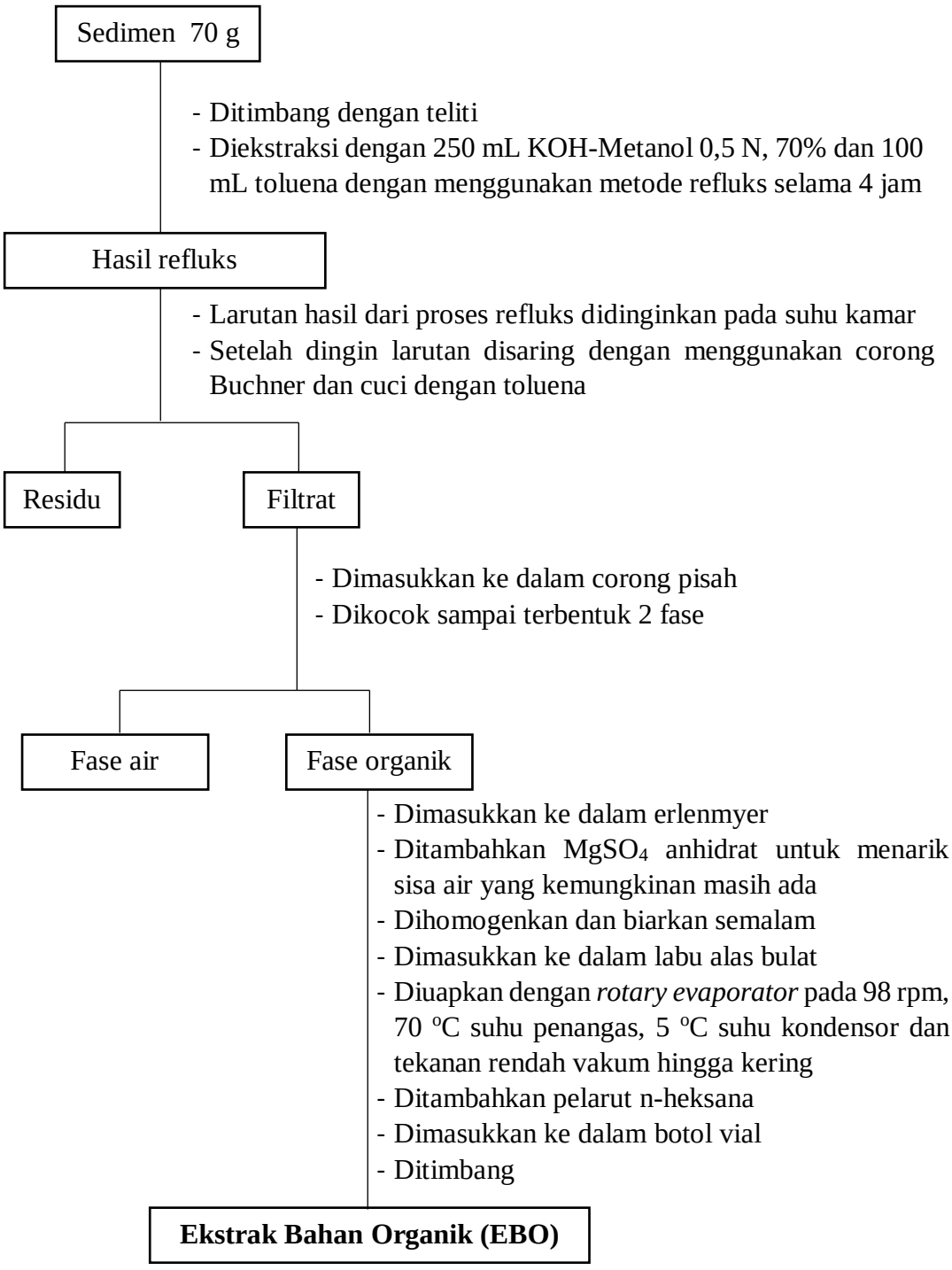
2. Penentuan Kadar Air

Sedimen

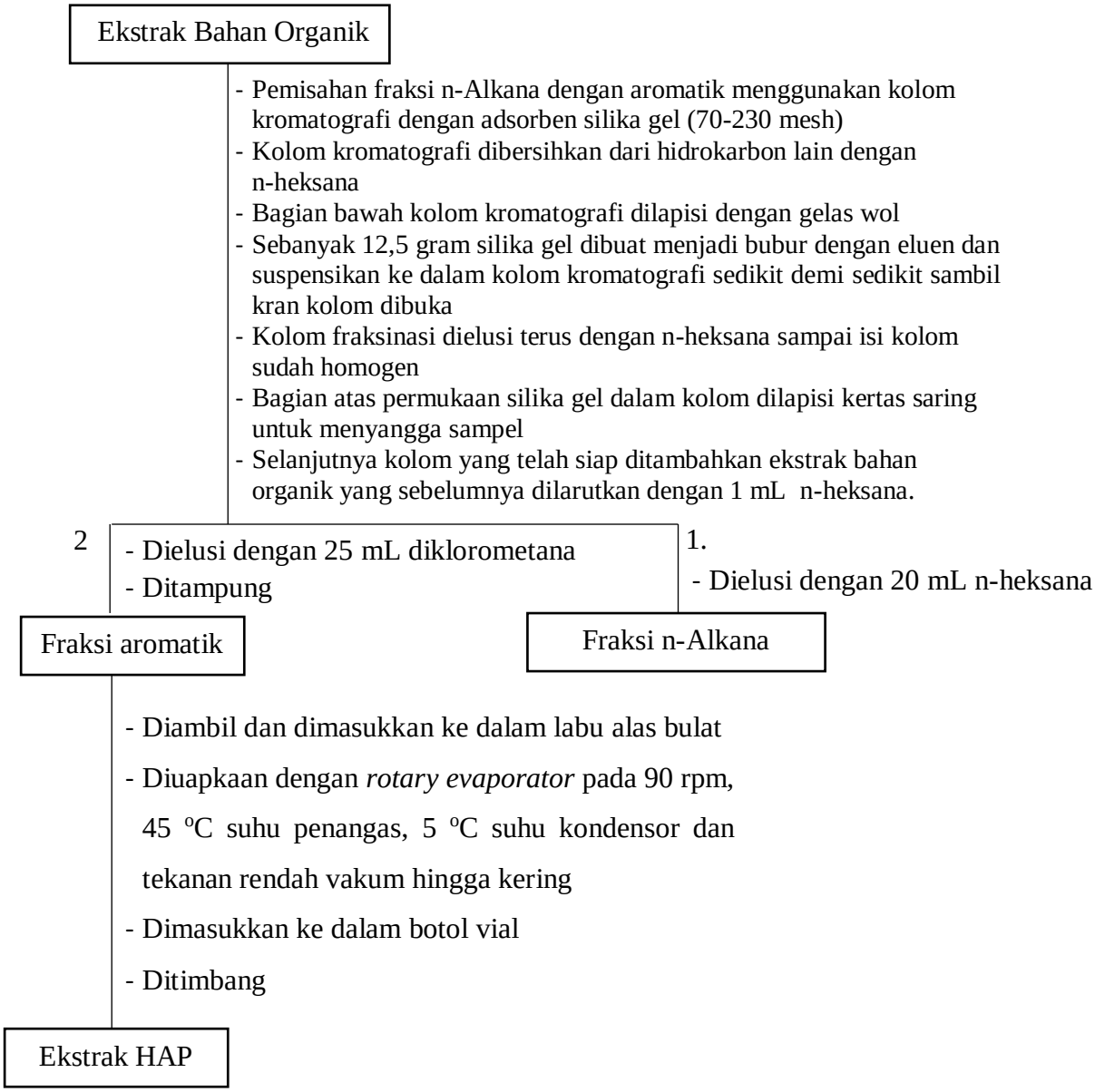
- Dipisahkan dari benda asing yang bukan contoh uji
- Ditimbang dengan teliti sebanyak 70 gram menggunakan cawan petri yang telah diketahui bobot kosongnya
- Dimasukkan dalam oven pada suhu 105 ^{0}C selama 6 jam
- Didinginkan dalam desikator lalu ditimbang hingga bobot konstan untuk mengetahui jumlah air yang hilang
- Dihitung kadar air

Sedimen kering

3. Penyiapan Ekstrak Bahan Organik (Melawaty, 2002)

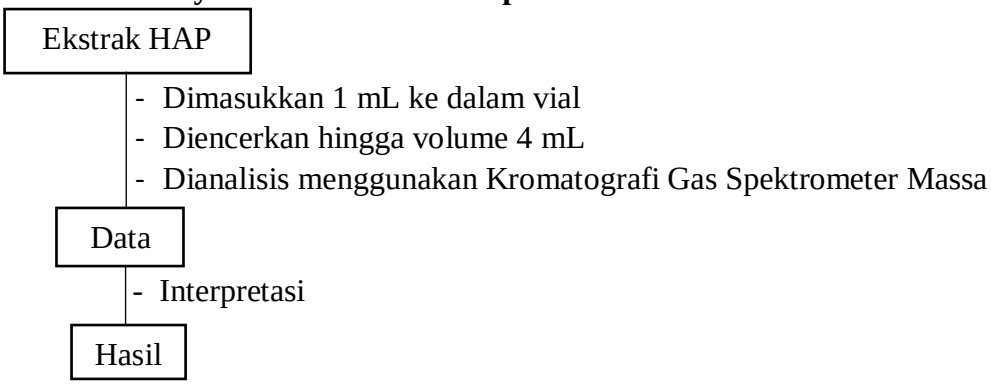


4. Pemisahan Fraksi n-Alkana dan Fraksi Aromatik (Melawaty, 2002)

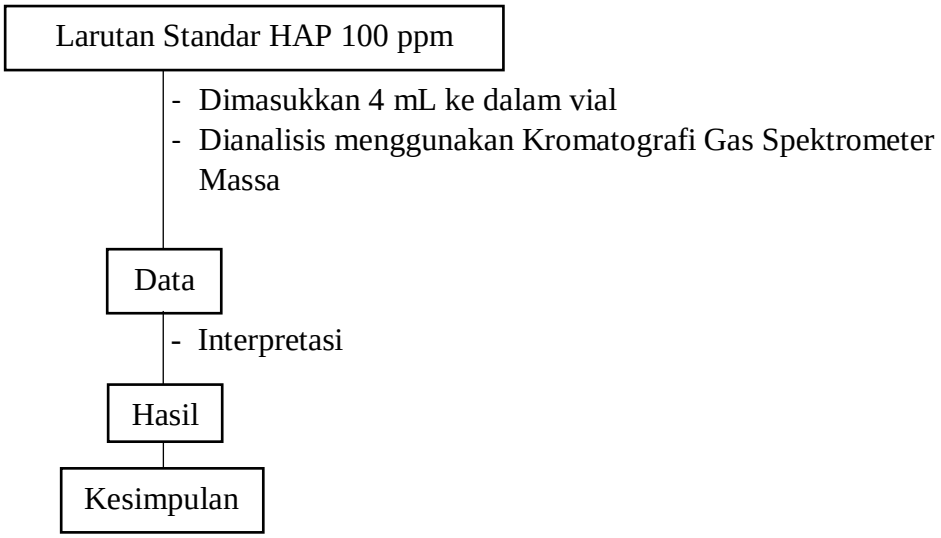


5. Analisis Senyawa Hidrokarbon Aromatik Polisiklik (HAP) dengan Kromatografi Gas Spektroeter Massa (GC-MS)

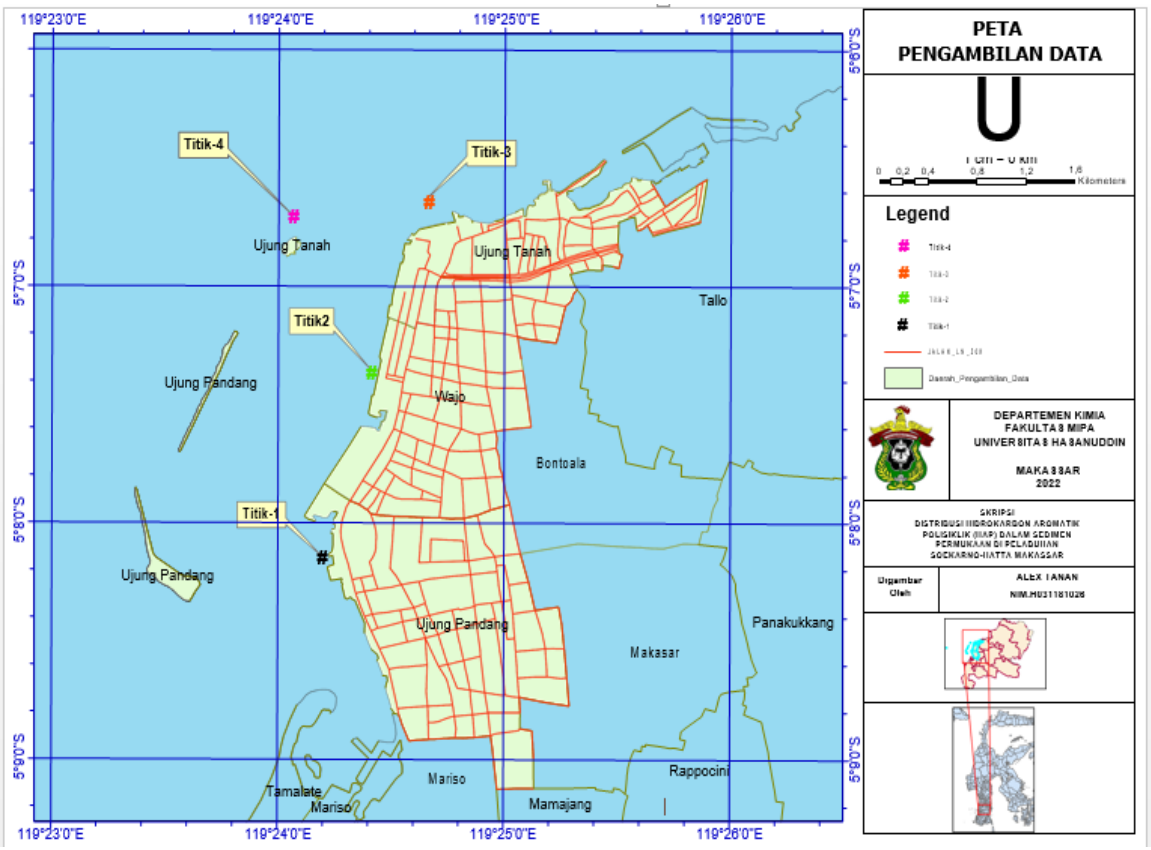
a. Analisis Senyawa HAP dalam Sampel



b. Preparasi dan Injeksi Standar HAP + IS



Lampiran 3. Peta Lokasi Pengambilan Sampel



Lampiran 4. Perhitungan

4.1 Perhitungan Kadar Air

$$\%KA = \frac{W1 - W2}{W1 - W0} \times 100\%$$

Keterangan :

W0 = Bobot cawan

W1 = Bobot cawan + sampel basah

W2 = Bobot cawan + sampel kering

a. Stasiun 1

$$\%KA = \frac{W1 - W2}{W1 - W0} \times 100\%$$

$$\%KA = \frac{(116,2313 - 91,0424)\ g}{(116,2313 - 46,2282)\ g} \times 100\%$$

$$\%KA = \frac{25,1889}{70,0031} \times 100\%$$

$$\%KA = 35,9826\%$$

b. Stasiun 2

$$\%KA = \frac{W1 - W2}{W1 - W0} \times 100\%$$

$$\%KA = \frac{(118,0493 - 91,0986)\ g}{(118,0493 - 48,0411)\ g} \times 100\%$$

$$\%KA = \frac{26,9507}{70,0082} \times 100\%$$

$$\%KA = 38,4965\%$$

c. Stasiun 3

$$\%KA = \frac{W1 - W2}{W1 - W0} \times 100\%$$

$$\%KA = \frac{(105{,}5907 - 75{,}2849)\ g}{(105{,}5907 - 35{,}5344)\ g} \times 100\%$$

$$\%KA = \frac{30{,}3058}{70{,}0563} \times 100\%$$

$$\%KA = 43{,}2592\%$$

d. Stasiun 4

$$\%KA = \frac{W1 - W2}{W1 - W0} \times 100\%$$

$$\%KA = \frac{(104{,}6343 - 87{,}0991)\ g}{(104{,}6343 - 34{,}5402)\ g} \times 100\%$$

$$\%KA = \frac{17{,}5352}{70{,}0941} \times 100\%$$

$$\%KA = 25{,}0167\%$$

4.2 Perhitungan Bobot EBO

$$W = \frac{1000\ (g/kg)}{\text{Berat Basah Sedimen (g)}} \times \text{Berat EBO (g)}$$

a. Perhitungan Bobot EBO Stasiun 1

$$W = \frac{1000\ (g/kg)}{44{,}8142\ g} \times 0{,}07394\ g$$

$$= 1{,}6499\ g/kg\ \text{sedimen kering}$$

b. Perhitungan Bobot EBO Stasiun 2

$$W = \frac{1000\ (g/kg)}{43{,}0575\ g} \times 0{,}0741\ g$$

$$= 1{,}7209\ g/kg\ sedimen\ kering$$

c. Perhitungan Bobot EBO Stasiun 3

$$W = \frac{1000\ (g/kg)}{39{,}7505\ g} \times 0{,}0684\ g$$

$$= 1{,}7207\ g/kg\ sedimen\ kering$$

d. Perhitungan Bobot EBO Stasiun 4

$$W = \frac{1000\ (g/kg)}{52{,}5589\ g} \times 0{,}07486\ g$$

$$= 1{,}4243\ g/kg\ sedimen\ kering$$

4.3 Perhitungan Bobot FA

$$W = \frac{1000\ (g/kg)}{Berat\ Basah\ Sedimen\ (g)} \times Berat\ FA\ (g)$$

a. Perhitungan Bobot FA Stasiun 1

$$W = \frac{1000\ (g/kg)}{44{,}8142\ g} \times 0{,}0737\ g$$

$$= 1{,}6446\ g/kg\ sedimen\ kering$$

b. Perhitungan Bobot FA Stasiun 2

$$W = \frac{1000\ (g/kg)}{43{,}0575\ g} \times 0{,}0695\ g$$

$$= 1{,}6141\ g/kg\ sedimen\ kering$$

c. Perhitungan Bobot FA Stasiun 3

$$W = \frac{1000\ (g/kg)}{39{,}7505\ g} \times 0{,}0398\ g$$

$$= 1{,}0012\ g/kg\ sedimen\ kering$$

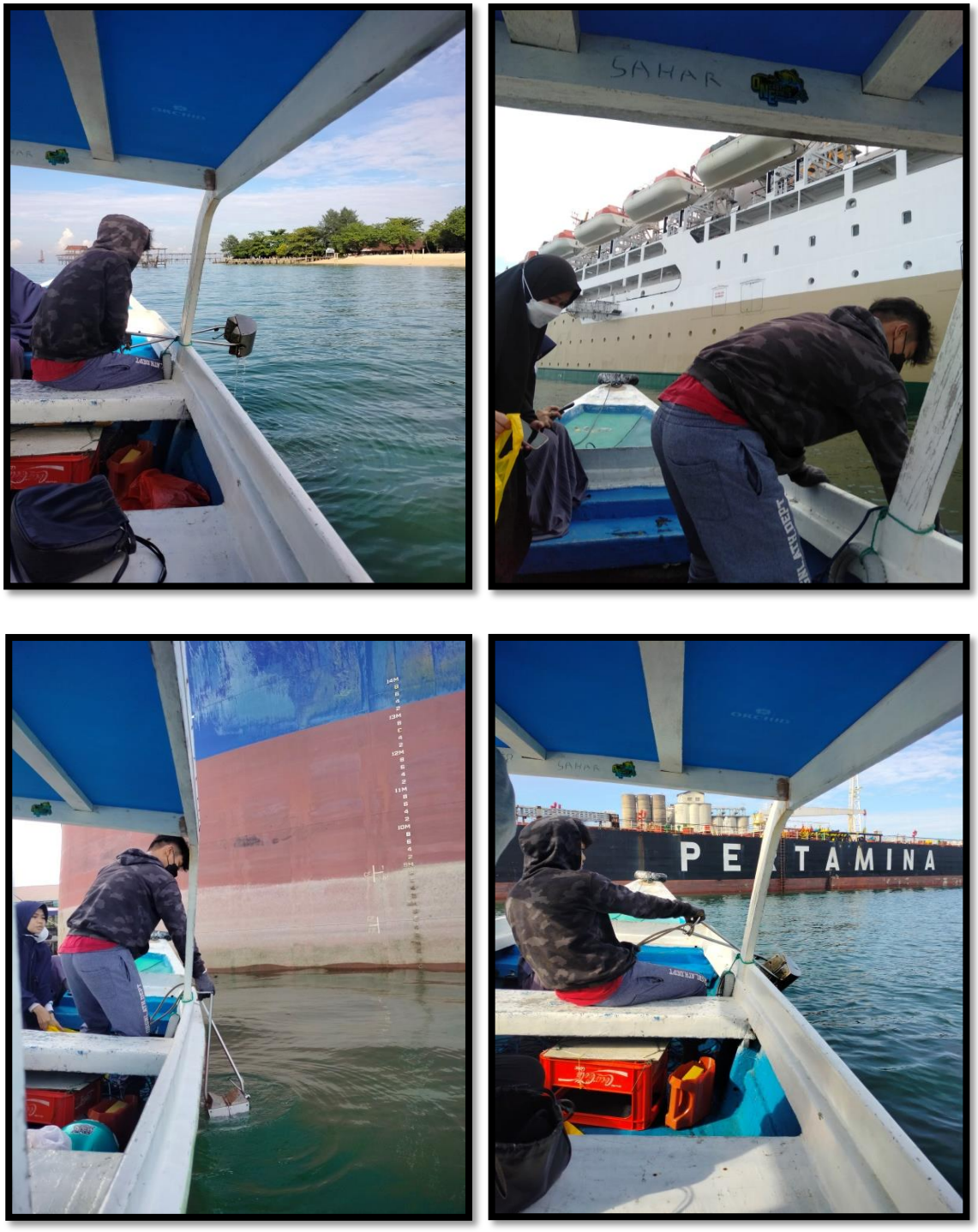
d. Perhitungan Bobot FA Stasiun 4

$$W = \frac{1000\ (g/kg)}{52{,}5589\ g} \times 0{,}0288\ g$$

$$= 0{,}5479\ g/kg\ \text{sedimen kering}$$

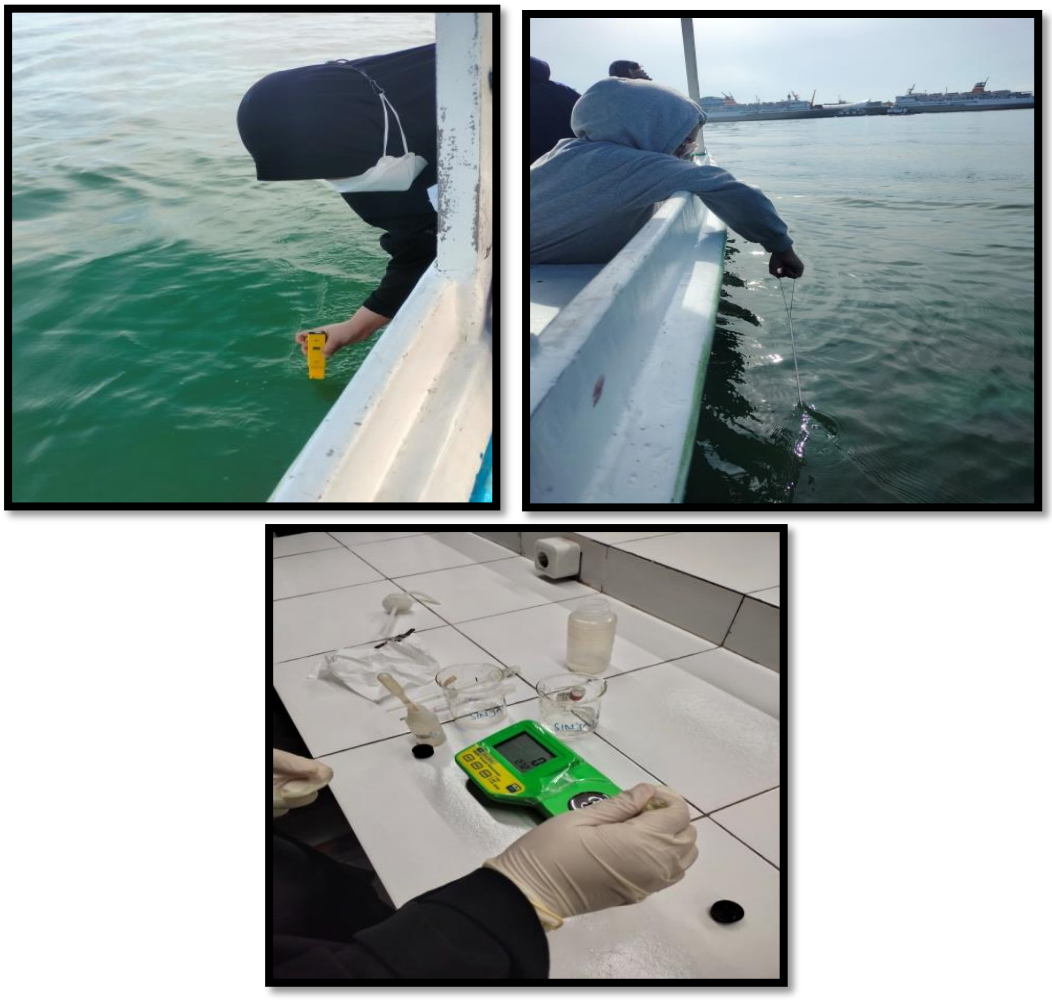
Lampiran 5. Dokumentasi Penelitian

5.1 Sampling



Pengambilan Sampel

5.2 Pengukuran pH, suhu dan salinitas



Pengukuran pH,suhu dan salinitas

5.3 Proses Homogenasi Sampel Sedimen

Homogenasi sampel

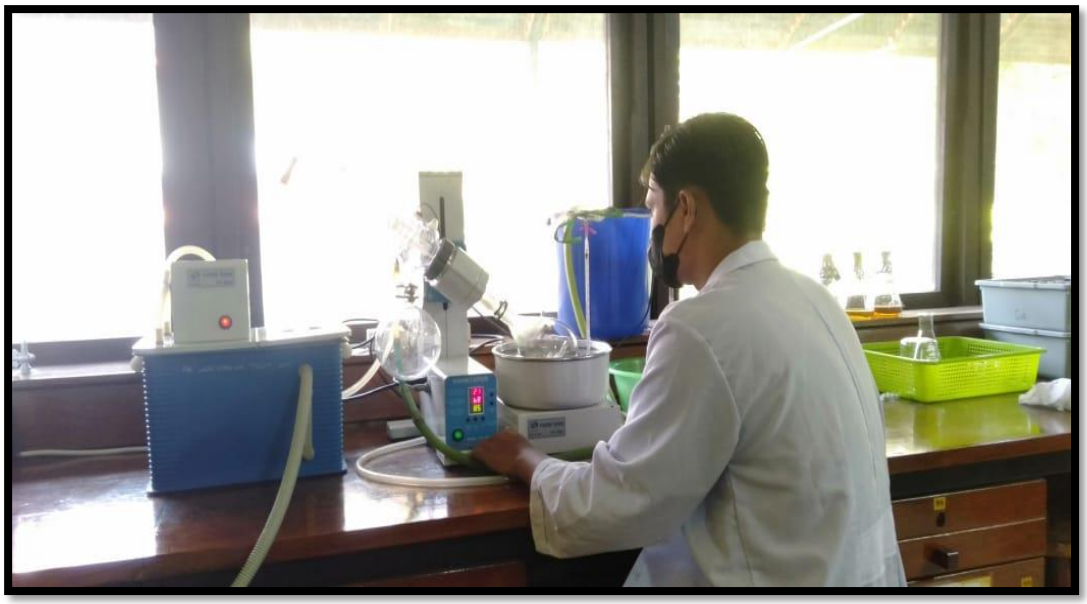
5.4 Pembuatan Pelarut

Proses pembuatan pelarut

4.5 Proses Refluks Sampel

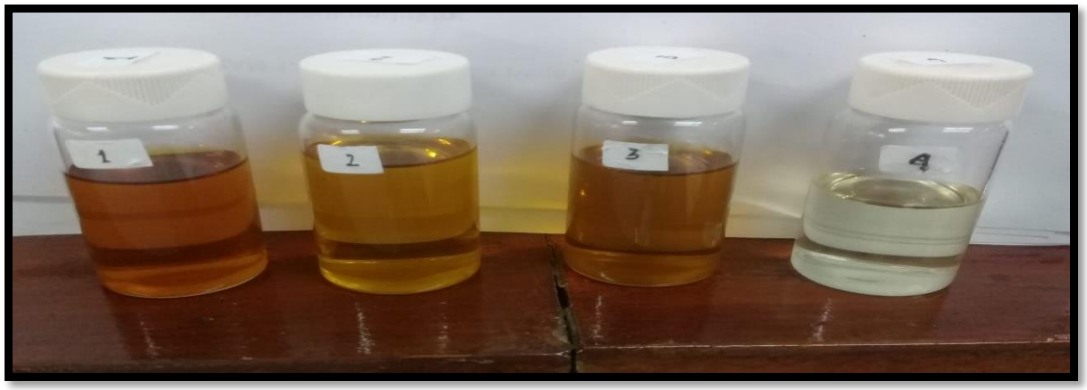
Refluks sampel dengan soxhlet

5.6 Proses Evaporasi Pelarut



Evaporasi pelarut

5.7 Hasil Evaporasi Ekstrak Bahan Organik (EBO)



Hasil EBO

Evaporasi pelaru EBO

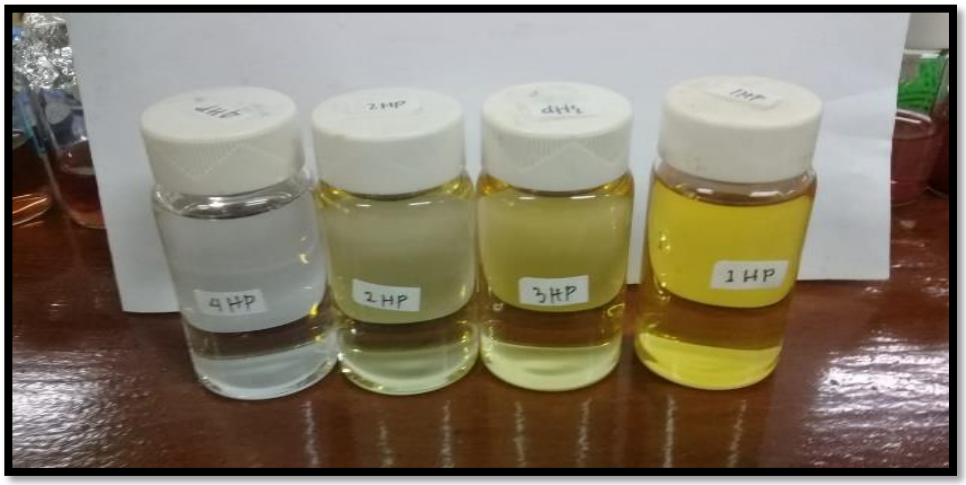
5.8 Penimbangan Bobot EBO

Proses penimbangan EBO

5.9 Proses Pemisahan Fraksi Alkana dan Fraksi Aromatik

Proses kolom kromatografi (pemisahan)

5.10 Hasil kolom kromatografi



Hasil kromatografi ekstrak HAP sebelum dievaporasi

5.11 Hasil evaporasi pelarut diklorometana dan penimbangan ekstrak HAP

Hasil evaporasi diklorometana dan penimbangan ekstrak HAP

5.12 Proses Injeksi Sampel ke GC-MS

Proses analisis ekstrak HAP dengan GC-MS