bioplastic sample. There is also the fact that with the addition of filler then the value of the water resistance is reduced. It is based on other factors, for example in the process of drying in the oven, where sometimes there are technical problem that the death of the electrical energy from PLN's channel. It has consequences in drying the bioplastics samples which are uneven so the initial sample weight will be different from other bioplastics sample.

Density (mass/volume) is the physical properties of a polymer. The more tightly a material, the better mechanical properties where the plastic film which is produced has a good tensile strength. This bioplastic density was determined using the increasing of fluid in the measuring cup. Effect of chitosan concentration on the density can be seen in Fig. 7.

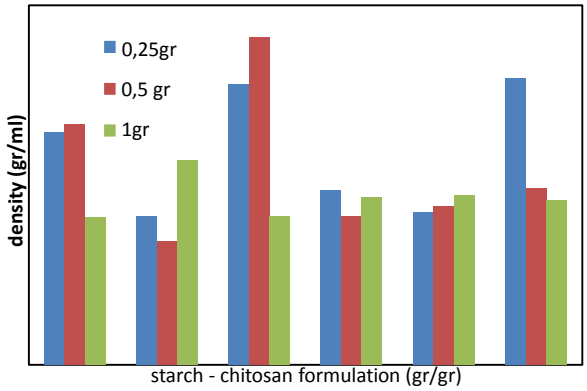

Fig. 6. The relationship between variation of starch: chitosan (g/g) and filler on density of bioplastics

Based on Fig. 6, it can be seen that there are the best conditions obtained from a density test ofbioplastics sample. Best condition on the formulation of starch-chitosan-filler are 7.5:2.5:0.25 (g/g) with values obtained at 0.291 (g/ml). From the result is density test of a bioplastics sample can be concluded that there are various factors in influencing the density of a bioplastics sample. This is based on the more dense molecular structure of the material, it will be stronger.

D. *Fourier Transfer Infra-Red (FTIR) analysis*

Based on the results of functional groups bioplastic samples test at various ratios of starch-chitosan, obtained the information several peaks appear. The emergence of a lot of peak indicates that in bioplastics there are many types of functional groups. Based on IR spectra bioplastics formulation of starch-chitosan-filler 7.5:2.5:0.25 (g/g) there is also a hydroxyl group (-OH) on the absorption area from 3567.04 to 3446.79 cm^{-1}, this group shows the breaking point. There is a group (C-OH) the absorption area is at 1078.02 cm^{-1} and there is also a amide group (C=0) the absorption area is from 1651.42 to 1561.43 cm^{-1}. And to the lowest point at 779.63 cm^{-1} the absorption area is phenyl group. The difference lies in the lowest point that there are group (C-Cl) for the variation of 10:0: 0.25 and phenyl group for variation of 7.5: 2.5: 0.25.

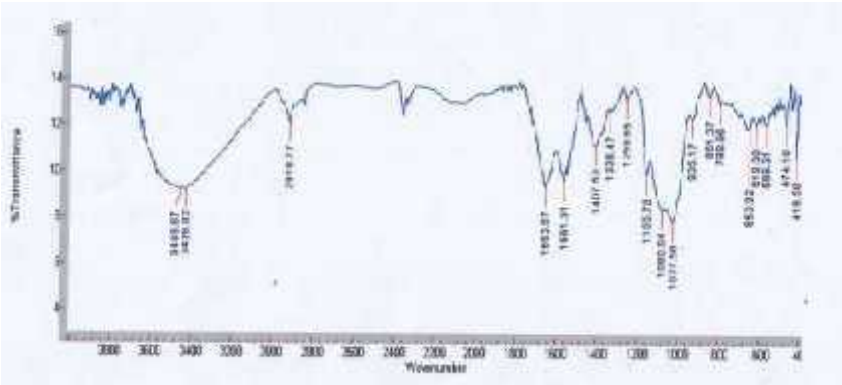

Fig. 7. Bioplastic FTIR Spectrum with Ratio Starch-Chitosan-Filler 6,5 : 2,5 : 0,5 (g/g)

IV. Conclusions

Characteristic of bioplastic that have resembled with LDPE is obtained on the starch: chitosan formulation variations 7,5 : 2,5 (g/g) with the addition of 0,25 g filler. The best tensile strength as mechanical strength characteristic of bioplastic film is 13,9957 Kpa.

List of Notation

Sym.	Definition	Unit
τ	Tensile Strength	MPa
F_{max}	Maximum Strain	N
A	Wide of Surface	(mm^2)
ε	Percent Elongation	%
L_1	Length of Bio Film	mm
L_0	Initial Length Film	mm
σ	Tensile Strength	MPa
W	Sample Weight	G
W_0	Int. Sample Weight	G
ρ	Density	g/ml
m	Sample Mass	g
v	Volume	ml

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References

[1]. Bayandori,M.A., Badraghi,T.N., & Kazemzad, (2009). Synthesis of ZnO nanoparticles and elecrodeposition of polyrole/ZnO nanocomposite film. Int J Electrochem Sci, 4, 247-257.

[2]. Yusmarlela. (2009). Studi Pemanfaatan Plastisiser Gliserol Dalam Filler PatiUbi Dengan Pengisi Serbuk Batang Universitas Sumatera Utara Medan,Thesis Master.

[3]. Suarni. 2004. *Evaluasi Sifat Fisik dan Kandungan Kimia Biji Sorgum Setelah Penyosohan.* Jurnal Stigma xii(1): 88-91.

[4]. Ban, Weiping, Song, Jianguo, Dimitris S. Argyropoulos, Lucianus A. Lucia. (2006). Improving The Physical and Chemical Functionally of Starch – Journal of Applied Polymer Science 2006 Vol. 100. P 2542-2548, Published online in Wiley www.interscience.wiley.com United States.

[5]. B2PT-BPPT. (2011). Proses Powdering Batang Sorgum. Negara Bumi Ilir, Anak Tuha. Lampung Tengah. Lampung

[6]. ASTM D882-97, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.

[7]. Rasato, Dominick V. (2004). Plastic Product Material & Proses Selection. Elsevier.

Chapter 2

Radiometric Correlation to Sulphur and Iron Content at BM-179 Kalan-West Kalimantan Uranium Ore

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Abstract. The research aims to determine the correlation radiometeric against sulphur and iron content and its association with uranium content of BM-179-Kalan-West Kalimantan's uranium ore. The sample selection method using a ROS tool–NF-SPP; enrichment of sulfide minerals using flotation preparation; Iron content determination using with AAS-Spectr-AA-20(λ=248.3 nm) analysis; uranium content through spectral uranyl- Br-PADAP (λ=574 nm) analysis; sulphur content determined by ESCHKA modification method. Results of the study is a linear correlation between the radiometric uranium content to follow the equation y_1=3,5408x+1867.3; sulphur content decreased with radiometric increasing with the equation y_1=-0,8345x+18926; iron content decrease to radiometric increase with the equation y_2=-1,351x+31261. Increased sulphur content followed by iron content increase with trendline y_1 = 1,3175x2 + 5601. The results can be found that the ore will have a high uranium content with a minimum sulphur content in radiometric ≥ 4000 cps, and a high uranium content with a minimum iron content at radiometric ≥ 6000 cps.

Keywords: BM-179-Kalan uranium ore, ESCHKA, radiometric correlation, iron, sulphur.

I. Introduction

BM-179 uranium ore is an ore sampel from the tunnel at a depth of 179 meters that are in Kalan, Ela Sub- district, Melawi District, West Kalimantan Province. The ore is precisely located in the hill Eko-remaja sector. To reach this location can be reached by air or land as far as ± 500 km to the East from Pontianak to Nanga Pinoh City, followed by ground vehicle through the timber company road along ± 70 km to the south.

Uranium ore from the Eko-Remaja-Kalan sector is still not used by the Indonesian government for various purposes related to energy, whereas in this sector have a high enough uranium reserves with a reserve of about more than 12409 tonnes of U_3O_8 [17].

BATAN has made exploration tunnel along the 618 meters at the Eko-remaja sector for the purposes of research and development of nuclear energy. BATAN has succeeded in processing BM-179 ores becomes "yellow cake" (U_3O_8) at various stages of processing, starting from the physical preparation, leaching, solid-liquid separation, purification and precipitation.

Uranium deposits in the BM-179 Eko-remaja-Kalan ore contain minerals other than uranium (uraninite, Branerit. Davindit and Gummit), still contain other minerals association such as pyrite, pirholit, kalkoporit, cobaltite, lollingit, pentlandite, gerdorsfit, saflorit, sphalerite, molybdenite, ilmenite, magnetite and chlorite [16] in it contains many minerals sulfide [17] and elements of economic value in addition to uranium metal such as transition metals. In addition, the amount of sulfide minerals in the Eko-remaja ore also can be used as byproducts that can be a source of efficiency in the processing of uranium. Through physical preparation methods with ROS (radiometric ore sorting) can be assumed to be used to separate the high sulfide mineral ores and containing high-grade uranium ore. High grade sulphide ore with sulfide enrichment through flotation method of preparation, may be followed to create sulphuric acid that is used to reduce acid consumption in the leaching stage at uranium production.

Research related to the physical chemistry characteristics of the transition and sulfide elements present in the BM-179 Kalan-West Kalimantan uranium ore has not been widely known and yet to be published. Therefore, this study was intended to determine the radiometric correlation against sulphur and iron content and its relevance to the content of uranium in BM-179 Kalan-West Kalimantan uranium ore.

By knowing the correlation between the elements content present in the BM-179 Kalan uranium ore, the next benefit of the data results obtained can be used to assist decision-making related to uranium exploration in Kalan-West Kalimantan and streamline all phases of exploration and exploitation activities in the future.

Implementation of this study to analyze and find correlation to the content of potential elements such as uranium, iron and sulfide through ROS (radiometric ore sorting) on BM-179 Eko-remaja Kalan West Kalimantan uranium ore.

The method used for the sample selection used ROS (radiometric ore sorting) by means of SPP-NF, for the enrichment of sulphide mineral conducted with flotation preparation method, to determine the iron element content is analyzed by atomic absorption spectroscpy (AAS) method, and to observe the uranium content used spectrophotometers, as well as for the sulphur content determination is used gravimetric method.

II. Procedure

2.1. Equipment and material experiment

The equipment used is a furnace, metal / glass pipe / heat-resistant rubber, condenser, thermometer, oven, ph-meters, glassware (test tube, beaker Glass, measuring cup, erlenmeyer, pipette, etc.), heater, grandsaw, jaw crusher, disk milk, mortar grinder, -65 mesh sieve, flotation apparatus, goach cup, spectrophotometers, AAS.

Materials used are examples of BM-179-Eko remaja-Kalan uranium ore, oxygen gas, pure sulphur, litmus paper, Whatman filter paper # 42, ascorbic acid, triethanolamine, ethyl xantat 10%, NKY-SNB, fine oil , coarse filter paper, asbestos, methyl isobutyl ketone, HNO_3, concentrated sulphuric acid, TOPO, $Fe_2 (SO_4)_3$, U_3O_8 and H_2O_2, amyl xanthat, Na_2CO_3, ZnO, $BaCl_2$ 10%, 2,5N KOH, HNO_3 (6: 1), HF concentrated, universal litmus paper, alcohol, 2.5 N HNO_3, ascorbic acid 5%, 2% NaF, Br-Padap 0.05%, concentrated $HClO_4$, HCl (1: 1), the standard elements of the brand Titrisol (U, Fe), asetilene.

1) Flotation preparation: A total of 500 grams of BM-179 ore with mesh size 65, added water to produce pulp percent solid 30%, included in the German Wedag flotation tool using rpm 1400. Pulp stirred while at pH 8 with 10% sodium carbonate. Furthermore added promother xanthat reagent much as 0.15 mL Ana amyl and fronther pine oil as much as 0.05 mL and left stirred for 5 minutes. Float concentrate separated carefully at the reservoir. The time of separation is done 10 minutes. Furthermore, the concentrate was filtered, the solids are heated in an oven and weighed and analyzed further.

2) Sample Preparation: A sample is analyzed are BM-179 ores with radiometric <150 cps, 150-500 cps, 500-1000 cps, 1500-3000 cps, 3000-5000 cps, and 5000-15000 cps. Examples with each radiometric weighed as much as 1 gram, put in a Teflon beaker, added 12 mL HNO_3 for 30 minutes (do not boil) with a hot plate on 200^oC temperature, left 5 minutes, the solution was removed, added another 12 mL HF concentrated and 4 mL $HClO_4$ concentrated, evaporated to dryness. The solution was removed and allowed to cool, added another 4 mL $HClO_4$ concentrated, heated to dry. Furthermore, the temperature is lowered to approximately 100 °C and added 4 ml of HCl (1: 1) and 10 mL distilled water, heated on a hot plate until solved. The solution was put in a 100 mL volumetric flask is diluted with distilled water, pipette 1 ml is inserted in a flask of 100 ml from 100 mL sample solution, added 2 ml HCl concentrated, added 10 mL 10% $CsCl_2$, diluted with distilled water to mark a line on each radiometric to be measured by AAS.

2.2. Iron analysis using an atomic absorption spectroscpy

1) Preparation of standard solution: Fe standard solution is made of standard elements Titrisol brands. Standard Fe dissolved in 1000 mL volumetric flask with distilled water.

2) Analysis of iron: Created standar solution series in 0; 0.5; 1; 2; and 5 ppm of iron standard solution parent, measured by AAS Varian Spectr AA-20 Plus using Fe lamp

56-100027-00 No.JT574 series, photomultiflier 421.8 volts, the wavelength of 248.3 nm, slit width of 0.2 nm , flate-asetilene air, asitilene flow of 1.5 L / min with a flame oxidation.

2.3. Product Specification and Controls

1) Preparation of solution: (a) TOPO weighed 19.28 grams of TOPO dissolved in Cyclohexane, diluted to 1 liter, so get 0.05 M TOPO solution; (b) 5% solution of ascorbic acid; (c) Complex solution I: 25 grams titriplex IV, 5 grams NaF and 65 grams sulfosalicilat acid dissolved in 800 ml of distilled water while stirring. Added NaOH solution is added gradually until pH = 8.35, then the solution is diluted to 1000 ml with aquadees; (d) Solution Complex II. One part of complex solution diluted with one part distilled water, then the pH is set to be 8.35 with 40% NaOH; (e) buffer solution pH=8.35: as much as 149 grams (134.04 ml) of triethanolamine dissolved in 800 ml of distilled water, neutralized with $HClO_4$ to pH 8.35 and kept overnight, next day pH was adjusted back to 8.35 with $HClO_4$, diluted with distilled water to 1 liter; (f) Br-Padap 0.05%: Br-Padap 0.5 grams dissolved in one liter of alcohol.

2) Analysis of Uranium: (a) Weighed 2 g sample of ore that has been finely ground, put in a teflon beaker. Added 30 ml $HClO_4$ + HNO_3 (6: 1), and concentrated HF. The solution was slowly heated on a hot plate for 1 hour while closed. Then dried at temperature 250 °C to form a paste. Paste dissolved with 2.5 N HNO_3, put in a 50 mL volumetric flask; (b) 1 mL pipette inserted into the shake flask, added 2 mL 5% ascorbic acid, 2 mL 2% NaF and 5 mL of 0.05 N TOPO. The mixture was shaken for 2 minutes, then allowed 5 minutes to separate the organic phase from the aqueous phase well; (c) pipette 2 ml of the organic phase, put in a 25 mL volumetric flask, then added 1 ml solution of complex II, 1 ml of buffer solution pH 8.35, and 2 ml of Br-Padap 0.05%. At each addition of the reagent, the solution was shaken well. After 10 minutes, added alcohol so that the solution exactly 25 mL. Uranyl spectrum-Br-Padap measured with a spectrophotometer at a wavelength of 574 nm, blank worked as an example.

2.4. Sulphur Determination by the modification ESCHKA method

Weighed 1 g sintering reactant (a mixture of Na_2CO_3 and ZnO ratio of 3: 2) inserted into an empty porcelain cup. Weighed 2 g ore sample was mixed with 15 g of sintering reagent, then insert it into the cup that has been filled sintering reagent. Added another 2 g of a mixture of sintering sprinkled on the sample in the cup.. The cup is closed, then heated in a furnace at a temperature 800 ° C for 2 hours. Once cool, put in a glass beaker containing distilled water approximately 200 mL and then heated to boiling approximately 10 minutes. The solution is filtered, the residue washed with hot water several times so that the volume of approximately 400 mL. Filtrate added with concentrated HCl dropwise until the CO_2 depleted, then added HCl excess. The solution is heated to approximately 350 mL. Added 15 mL of 10% $BaCl_2$ while stirring to form a precipitate, sediment left overnight. The precipitate is filtered with Whatman filter paper No. 42, subsequently burnt at 800 °C.

III. Equations

Absorbance was measured using Atomic Absorption Spectroscopy using the equation:

$$A = -\log T \quad (1)$$

Where

A = Absorbance
T = Transmission

Beer's law states that the absorbance is directly proportional to the thick solution

$$-\int_{Io}^{I} \frac{dI}{I} = \int_{0}^{n} \frac{dS}{S} \quad (2)$$

Where

I = Reduction intensity
S = cross-sectional area that absorbs particles

Absorptivity and molar absorptivity measured by the equation:

$$A = \varepsilon * b. * c \quad (3)$$

Where:

A = Absorbance
ε = constant absorption
b = bold solution
c = concentration of the solution

In the settlement equation using non-homogeneous linear equation:

$$a1x1 + \ldots + akxk = b \quad (4)$$

With a1, ... , ak value of R, to be able to determine menentukan x1, ... , xk with values of R, and, if present, will give an answer. The results are obtained if b belongs to the ideal value generated by a1.

Sulphur content can be obtained from the determination of the weight of $BaSO_4$ prior with ESCHKA modification method, further calculations are:

Contents of $(SO_4)_2$- (in %) = [($(SO_4)_2$- / $BaSO_4$) x Weight $BaSO_4$ x 100%] / Heavy example.

Contents of S (in %) = [Weight Atom S / Molecular Weight $(SO_4)_2$-] x % $(SO_4)_2$- (5)

IV. Results and Discussion

The content of sulphur and iron elemental in BM-179 Eko-remaja ore is a major potential element in addition to the uranium. Analysis results of the lowest radiometric elemental average for 75 cps sulphur content was obtained 23452 ppm and an iron content is 40309.6 ppm whereas the uranium content is 470 ppm, whereas for the highest radiometric average of 10000 cps was obtained at sulphur content is 11450 ppm, the iron content is 18489,2 ppm, while the uranium content obtained for 35842 ppm.

The results showed that the higher the radiometric of BM-179 Kalan ore have greater uranium content, while the sulphur and iron content showed that the higher the radiometric BM-179 ore containing lower sulphur and iron content.

Such correlations can be presented in Figure 1 where the x-axis is the uranium content and the y-axis is the sulphur and Iron content.

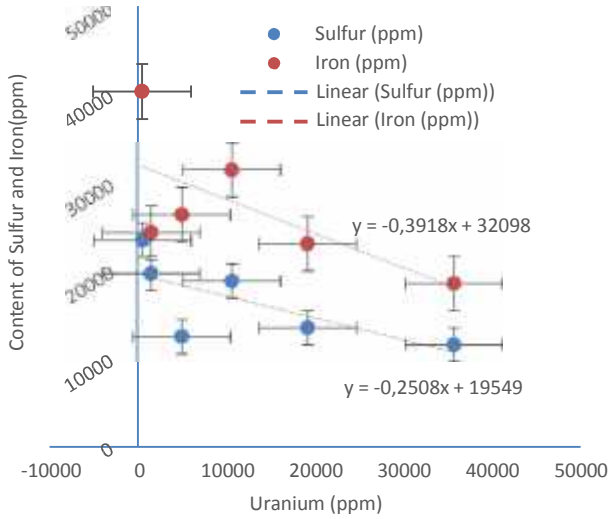

Fig 1. Graph uranium content of the sulphur and iron in BM-179 Kalan-West Kalimantan uranium ore

Figure 1 shows that the rise in uranium content will be followed by a decrease in sulphur and iron with trendline follow linear line equation y1 = -0,3918x + 32098, where $y_1$zz is the iron content and x is uranium content with a constant of iron content is 32098 ppm, whereas for the content sulphur follow trendline follow linear line equation y_2 = -0,2508x + 17328, where y_2 is sulphur and x is uranium content with the constant of sulphur content is 19549 ppm.

Correlation between sulphur and iron content in BM-179 Kalan West Kalimantan uranium ore show the relationship is directly proportional, meaning that the higher sulphur content and the higher the iron content contained in the ore. The relationship between sulphur and iron can be presented as Figure 2.

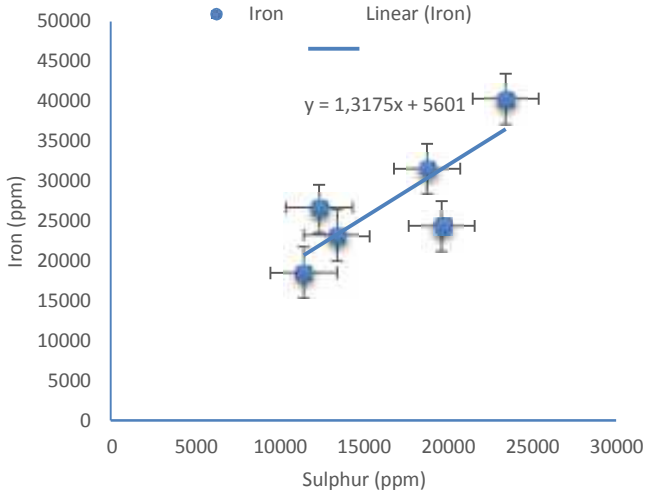

Fig 2. The sulphur content correlation of the iron content in the BM-179 Kalan West Kalimantan uranium ore

Figure 2 shows that the higher sulphur content will be followed by an increase in iron content by following the trendline linear line equation follows $y_1 = 1{,}3175x_2 + 5601$, where y_1 is the iron content and x_2 is the sulphur content, with constant of iron concentration is 5601 ppm.

The linear equation indicates that, in the BM-179 Kalan West Kalimantan uranium ore has a tendency relationship between the sulphur and iron content is the iron content has 1.3175 times larger than the content of sulphur. This indication may give the hypothesis that the BM-179 uranium ore has an iron compound which is quite high. There are many possibilities existing iron compounds, in addition to combining with sulphur to form

pyrite and iron (II) sulfide, can also form oxides in the form of hematite, limonite and magnetite, or to form carbonate compounds such as siderite, but it can form compounds such as silicates like taconit. Existing sulphur compounds can also be fused with uranium to form uranyl disulfide.

Radiometric relations with uranium content, sulphur and iron can be presented as Figure 3 below.

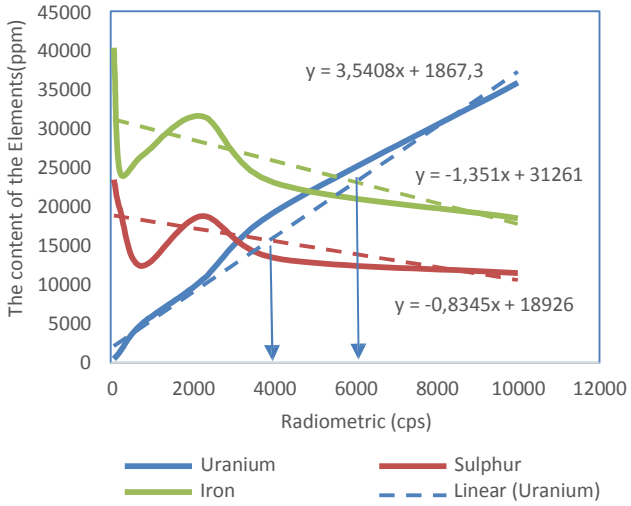

Figure 3. Graph relations of radiometric (cps) with a content of uranium, with sulphur and iron, and with sulphur and uranium.

Figure 3 shows that the content of uranium radiometric direct proportion to the equation y = 3,5408x + 1867.3, where y is the content of uranium and x is large radiometric, the higher radiometric information will be higher levels of uranium. Sulphur content follows the equation y=-0,8345x + 18926 against radiometric number, the higher radiometric provide information that will be even lower sulphur content. And Iron content to follow the equation y = -1,351x + 31 261 to the number of radiometric, meaning that the higher radiometric provide more information to low iron content. Figure 3 also provides information that intercept uranium and sulphur content shown on radiometric 4000 cps, so as to obtain a high uranium content in BM-179 Kalan West Kalimantan ores to minimize sulphur is at radiometric greater than or equal to 4000 cps. Intercept between uranium and iron content shown on radiometric 6000 cps, so as to obtain a high uranium content in the BM-179 Kalan West Kalimantan ore with an iron lies in the radiometric far greater than or equal to 6000 cps.

Please refer to the equations, tables and figures are as follows: (1) Equation (1), an excerpt made in accordance reference [1]; (2) Equation (2), an excerpt made in accordance references [2] - [4]; (3) Equation (3), an excerpt made in accordance reference [4] - [7]; (4) Equation (4), quotations in accordance with references [8]; (5) Equation (5), an excerpt made in accordance with references [1]; (6) Figure 1, Figure 2 and Figure 3, an excerpt made in accordance reference [8] - [17]; and (7) Table 1, an excerpt made in accordance references: [1] - [11].

V. Conclussion

The higher radiometric of BM-179 Kalan West Kalimantan uranium ore showed increased levels of uranium, therefore radiometric of BM-179 is directly proportional to the uranium content follows the equation y = 3,5408x + 1867.3, where y is the content of uranium and x is large radiometric.

The lower the sulphur content with increasing radiometric follow the equation y = -0,8345x + 18926. The iron content reduction of the radiometric will follow the equation y=-1,351x + 31261. The higher sulphur will be followed by an increase in iron content by following linear trendline equation $y_1 = 1,3175x_2 + 5601$, where y_1 is the iron content and x_2 is the content of sulphur, with constant iron content is 5601 ppm.

High uranium content in BM-179 Kalan West Kalimantan ores with to minimize sulphur is at radiometric greater than or equal to 4000 cps, high uranium content to minimize iron can be obtained at radiometric greater than or equal to 6000 cps.

Apendix

Appendix of results radiometric data of the analysis correlation with uranium, sulphur and iron content in bm-179 kalan west kalimantan uranium ore

The elements are analyzed in this study are the elements that are considered potential of major mineral include: sulfur, iron and uranium. Data analysis has been done may look like Table 1. Appendix A.

Table 1. Appendix A. The results of radiometric data and the uranium content, sulphur and iron in BM-179 Kalan-West Kalimantan ore

No	Central point Radiometric (cps)	Uranium (ppm)	Sulphur (ppm)	Besi (ppm)
1	75	470	23452	40309,6
2	225	1421	19648	24374,6
3	750	4919	12373	26413,7
4	2250	10595	18781	31552,3
5	4000	19213	13413	23055,7
6	10000	35842	11450	18489,2

References

[1]. Douglas A. Skoog; Donald M. West; F. James Holler; Stanley R. Crouch, “Fundamentals of Analytical Chemistry”, 8th Ed, 2003

[2]. Dean Calloway, “Beer-Lambert Law”, J. Chem. Educ., 1997, 74 (7), p 744.

[3]. Herman A. Liebhafsky and Heinz G. Pfeiffer; “ Beer's law in analytical chemistry”, J. Chem. Educ., 1953, 30 (9), p 450

[4]. D. F. Swinehart, “ The Beer-Lambert Law”, J. Chem. Educ., 1962, 39 (7), p 333

[5]. Ingle, J. D. J.; Crouch, S. R.,” Spectrochemical Analysis”. New Jersey: Prentice Hall, 1988.

[6]. L. Liua and I. Neretnieksa, “Sensitivity Analysis of Uranium Solubility Under Strongly Oxidizing Conditions”, MRS Proceedings, Vol. 556, 1999. Available: http:// dx.doi.org/10.1557/PROC-556-1001(About DOI)

[7]. Owen T. Butler,; Warren R. L. Cairns; Jennifer M. Cook and Christine M. Davidson, "2014 Atomic Spectrometry Update – A Review Of Advances In Environmental Analysis", Journal Anal. At. Spectrom., 2015.

[8]. Geoffrey R. Loftus,; Martin A. Oberg,; and Allyss M. Dillon, "Linear Theory, Dimensional Theory, and the Face-Inversion Effect", Psychological Review by the American Psychological Association, Vol. 111 (4), p.835- 863, University of Washington, 2004

[9]. Gribble,C.D., "Rutley's Elements of Mineralogy", 27-th Edition, London:Unwin Hyman, 1988.

[10]. John Emsley, "Nature's Building Blocks: An A-Z Guide to the Elements", 2nd Edition, New York: Oxford University Press, 2011.

[11]. Klein, Cornelis and Cornelius S. Hurlbut, Jr., "Manual of Mineralogy", 20th ed., Wiley, 1985. pp. 307–308 ISBN 0-471-80580-7

[12]. Burns, P.C., and Finch, R, "Reviews in Mineralogy, Uranium: Mineralogy, Geochemistry and the Environment.", Mineralogical Society of America, Vol. 38, U.S.A.:Washington D.C., 1999, ISBN 0-939950-50-2

[13]. Anthony, John W.; Bideaux, Richard A.; Bladh, Kenneth W. and Nichols, Monte C. (ed.). "Uraninite, Handbook of Mineralogy", Mineralogical Society of America, US: Chantilly, VA, 2011, ISBN 0-9622097-2-4.

[14]. Affandi, K.; Susilaningtyas; Tjokrokardono, S. dan Sastratenaya, A.S., "Laporan Internal Bidang Pengembangan Teknologi PPBGN: Status Pengolahan Bijih Uranium Eko remaja Kalan", Jakarta: BATAN, 2001.

[15]. Rifrandiyah, E.; Pudjianto R., "Laporaan Hasil Penelitian BATAN 1992/1993: Penentuan Kondisi Optimal Pelindihan Bijih Uraium Tipe BM-179 (TS-IV)". Jakarta: BATAN, 1993.

[16]. Affandi, K., "Scientis Exchange Program 1992/1993: Pretreatment and extraction of Uranium from Refractory Uranium Minerals", Japan: PNC, Ningyo Toge Works, 1993.

[17]. Tjokrokardono, S., "Prospek Pengembangan Cebakan Uranium di Kalan, Kalimantan", Jurnal Nuklir Indonesia, Himpunan Masyarkat Nuklir Indonesia, 1998, Vol. 1 (1), p. 1-12.

Chapter 3

Masterplan Road Network in the Border Region of Nunukan Regency of the North Kalimantan Province

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Abstract. The formation of the North Kalimantan Province especially Nunukan Regency, as one of the efforts in organizing the regional solutions in order to optimize the public service because it can shorten the span of control of the Government, making it more efficient and effective. Based on this, the need for adequate of traffic infrastructure andfacilities are necessary. The infrastructure and facilities in the form of network access roads and bridges in the whole transport system. Road and bridge infrastructure are essential for the realization of national development activities that support the development of production and services. It also support the development of a region to realize the harmony of region growth, urban and rural holistically organized, environmentally sustainable, and empower communities.

Keywords: Master Plan, Roads, Bridges, Nunukan, North Kalimantan

I. Introduction

Transportation is fundamental to economic development and the development of society and the growth of industrialization. With the transportation led to specialization or division of labor according to the expertise in accordance with the culture, customs and culture of a nation or the region. Where the road network is an important tool in the implementation of the transport. In line with the growth and development, then a region will not be separated from the presence of the transport sector which is the main supporter of the movement of people and goods, so the need for transport will be increased. The transport sector is the most important sector in the life of society and become the backbone of a country's economy in general.

One of the key elements in implementing transportation is the availability of good road network infrastructure and meet the development of the movement of people and goods, in particular in the province of North Kalimantan. The North Kalimantan province with an area of whole ± 75.467.70 km^2 and a total population of approximately 622.350 inhabitants has a network of road infrastructure that hasn't been fullest in optimizing public services especially in rural and border areas. Coupled with the general condition of the economy of Indonesia in the border region, among others, as follows:

a. Relatively isolated location (remote) with a low level of accessibility
b. Low levels of education and public health
c. The low level of socio-economic welfare of society border area (the number of poor and underdeveloped villages)
d. The scarcity of information about government and community development in the border areas

Condition of the territory

North Kalimantan Province is divided into five administrative regions consist of 1 (one) and 4 (four) districts, which are: Tarakan City, Bulungan Regency, Malinau Regency, Nunukan Regency, and Tana Tidung Regency originally was part of the province of East Kalimantan. Tanjung Selor is the capital city of North Kalimantan Province.

The formation of the province aims to encourage increased services in the areas of governance, development, community, as well as shortening the span of control in the Government especially in the area of the northern border. Expected also in the presence Of North Kalimantan Province can improve the economy of the North Kalimantan residents residing near the borders with neighbouring countries.

Geographically the province borders the countries of North Kalimantan Province Malaysia Sabah (North); West Kutai Regency, East Kutai, Kutai Kartanegara, and Berau (South); The Celebes Sea (East); and some parts of Borneo Malaysia Country Part (West). The area is also located in national and international cruise lines (Indonesia Islands/Sea Groove Archipelagic Sealand Passage) and exit (outlet) to the Asia-Pacific region. In geostrategic, North Kalimantan Provinve was the open gates to Malaysia (Sabah), Southern Philippines, and Brunei Darussalam.

At the time of Regional Expansion on 25 October 2012 by Regulation No. 20/2012, North Kalimantan Province has 38 subdistrictscomprising :

1) Tarakan City (4 sub-districts)
2) Malinau Regency (12 sub-districts)
3) Bulungan Regency (10 sub-districts)
4) Tana Tidung Regency (3 sub-districts)
5) Nunukan Regency (9 sub-districts)

During the period of ±1 (one) year until October 2013, the number of sub-districts undergoing expansion to 47 sub-districts, consisting of:

1) Tarakan City (4 sub-districts)
2) Malinau Regency (15 sub-districts)
3) Bulungan Regency (10 sub-districts)
4) TanaTidung Regency (3 sub-districts)
5) Nunukan Regency (15 sub-districts)

The North Kalimantan province has 2 (two) sub-districts bordering neighboring countries, North of Sabah (Malaysia) to the West, some parts of Borneo (Malaysia). The North Kalimantan area on 2 (two) of border districts namely 56.884,38 km2 comprises the area of the Malinau Regency 42.620,70 km2, and Nunukan Regency with a land area of 14.263,68 km2. Border area of Malinau 26.875, 03 km2 or 63,05% of the Malinau Regency, and the broad border area of Nunukan 10.928,78 km^2 or 76,61% of the area of Nunukan Regency.

Profile of Border Area of Nunukan Sub-district

Nunukan Regency is part of the province of North Borneo Province, along with the expansion of the new province of East Kalimantan province. Nunukan Regency is located in the capital city of Nunukan. The County in 2012 is made up of 15 sub-districts. The total area according to Nunukan Regency in can be seen in **Table 1**.

Table 1. Total area, number of villages and the capital per sub-district in Nunukan Regency

Sub-districts	*Unit*	*Total Area*	*Number of Villages*	*Capital*
Krayan	km^2	1.834,74	65	Long Bawan
Krayan Selatan	km^2	1.757,66	24	Long Layu
Lumbis	km^2	290,23	28	Mansalong
LumbisOgong	km^2	3.357,01	49	Samunti
Sembakung	km^2	2.042,66	20	Atap
Nunukan	km^2	564,50	5	Nunukan Barat
SeiMenggaris	km^2	850,48	4	Sri Nanti
Nunukan Selatan	km^2	181,77	4	Mansapa
Sebuku	km^2	1.608,48	10	Pembeliangan
TulinOnsoi	km^2	1.513,36	12	Sekikilan
Sebatik	km^2	51,07	4	TanjungKarang
SebatikTimur	km^2	39,17	4	SeiNyamuk
Sebatik Tengah	km^2	47,71	4	AjiKuning
Sebatik Utara	km^2	15,39	3	SeiPancang
Sebatik Barat	km^2	93,27	4	Binalawan

Source: BPS Nunukan Regency

II. Methodology

Road-handling activities are categorized in three types of programs, namely :

a. Programme of rehabilitation and maintenance of roads and bridges
b. Programme of building roads and bridges
c. Road and Bridge Improvement Program

The data is used, collected directly from primary or secondary field either through surveys and observations. Some of the activities of the survey conducted in the field include:

a. An inventory survey of the road network. Intended to provide a framework for priority handling and maintenance to carry out a systematic survey of the entire road network.
b. Review the previous programs. Before doing a detailed study will be conducted centrally and redenomination of program development and improvement of roads and bridges that have been done in previous years.
c. The collection of the Data sources. The majority of secondary data which is to be obtained from the Engineering Department of public works, the local Departments. Such data include the following :
   1) Spatial Plan area of North Kalimantan Province (RTRW Kalimantn Utara)
   2) Medium-term development plan of the North Kalimantan Province (RPJMD Kalimantan Utara)
   3) Master plan of the border regions of North Kalimantan Province
   4) Previous researchs and studies
   5) National Agency for Border Management (BNPP)
   6) Government regulations related to the border
   7) Road network inventory data

The other is socio-economic data, the physical condition of the area, the defense and security of NKRI within the scope of the border region, a system of transport conditions and the development plan of the region can be obtained from: BAPPEDA, Department of Agriculture, Department of Forest, Regional Office Of The Department Of Transportation, Department of Tourism, and the Department of Transmigration.

d. Preparation of Base Maps

The main purpose of this category is to correct the map base of the existing road network. These activities are required to photocopy the study area topographic map 1: 50.000 scale whenever possible. If topographic maps 1: 50.000 scale could not be retrieved will be used in a map with a smaller scale or a map of land use but can still be used for the determination of the location of his physical condition precisely, such as the great river, wide and most settlements are not part of the networks are still the same. Improvements and additions to the data can be done during the field surveys and the results will be redrawn on the appropriate scale.

e. Framework of the Population Data

It takes an estimated population served the standards proposed to determine the value of benefits if the roads will be improved from the condition cannot be traversed by vehicles or bad road conditions where vehicular traffic is very low, the road was upgraded into vehicle navigable throughout the year. This activity required to perform topographic maps 1: 50.000 scale indicating the names and approximate boundaries of each village/town sejajarnya with the path to the ruasnya, when possible. On the basic map made estimates of the involvement of each village/town against one or more extensive way based on the reality on the map, as well as the estimated population that can be served by roads and the result ditabulasikan undertook to facilitate the analysis of benefits.

f. Analysis of the Activity Centre

The purpose of this activity is to determine the location, characteristics and the relative size of all markets or events which simply means:

1) Help interpret network data path by specifying the activities of the centres needed to be centre of attraction to travel towards the Centre of the activity.

2) Help in determining the rate of interest on a road that is at the moment berangkali is experiencing traffic barriers according to the size and type of activity centres.

g. Framework of the Socio-Economic Data

To conduct a systematic study of the supporting framework required a form of socio-economic activities of the region information study, along with data on population, activity centers, data traffic and the road network. All this information is necessary to help interpret the data traffic, specify the heavy vehicle traffic that affect the design of the roughness, predict the level of change, and the upcoming traffic composition. Data checklist that can help in obtaining information required is:

1) The general statistics of the socio-economic
2) Project checklist transmigration and plantation data
3) Checklist of activities of the tourism sector data

III. Results and Discussions

Some problems on the existing road network in Nunukan Regency border regions such as (1) the lack of completeness of facilities such as road signs and road markings on the road who has been there, (2) Less the maximum functionality of the existing road conditions caused by the roughness of damaged roads, wide road that is not appropriate, non-working street drainage and interference addition high enough, and (3) The uneven development of the road network throughout the region. Thus causing some areas to be isolated.

Table 2. The Road Length in NunukanRegency

No	*Description*	*Volume*	*Unit*
1	Regency Road Length	522,68	km
2	Province Road Length	273,60	km
3	Villages/Local Road Length	25,984	km

Source :Nunukan Departement of Public Works

Table 3. The Road Length Based on Condition

No	*Description*	*Volume*	*Unit*
1	Good	409,23	km
2	Middle	187,45	km
3	Light Damage	38,55	km
4	Heavy Damage	59,74	km

Source :NunukanDepartement of Public Works

The construction of the road network is an important transport infrastructure to streamline the distribution of goods between regions as well as the increasing mobility of the population. As already explained above that it plans a major infrastructure network system in Nunukan Regency consists of:

1) Land Transportation Network System
2) Railways Transportation Network System
3) Sea transport Network System
4) Air transportation Network System

Plan of the development of the road network in Nunukan Regency, as follows:

a. National road network development plans in Nunukan Regency include:

1) National road network that serves artery
2) Segment Sebatik Island ring road is a national road that serves primary collector 1 (K-1).
3) National strategic road network.
4) The development of the National Strategic road network on roads Mansalong - Tau Lumbis and Nunukan Island Ring Road.
5) The development of theprovincial strategic road network, SeiManggaris - Tau Lumbis.

b. Network development roads plan in Nunukan regency such as construction, improvement and maintenance of district roads
c. The development plan of the bridge in Nunukan

d. Network Infrastructure Road Transport Traffic

e. The airport feeder in Nunukan is Juvai Semaring airport in sub-district Krayan and Long Layu airport in the sub-district of South Krayan. Special airports in Nunukan.

Based on the results of the survey in the border region of North Kalimantan province Nunukan district, it can be seen:

Table 4. The Level Of Travel Based On Intent To Travel

No	*Purpose of Travel*	*Number*	*Percentage*
1	Family visit	88	28,39
2	Business	18	5,81
3	Work	55	17,74
4	Tourism	28	9,03
5	Shopping	112	36,13
6	Others	9	2,90
Total		310	100,00

Table 5. The level of Travel Based on The Mode Used

No	*Mode*	*Number*	*Percentage*
1	Motorcycle	93	30,00
2	Cars	69	22,26
3	Boat/Speedboat	107	34,52
4	Ship	19	6,13
5	Public Transport	8	2,58
6	Others	14	4,52
Total		310	100

Table 6. The Level of People Travel Daily

No	*Number of Trips*	*Number*	*Percentage*
1	1 time	163	52,58
2	2 times	138	44,52
3	3 times	9	2,90
4	4 times		0,00
Total		310	100

Table 7. The Level ofTravel Based On TheTransportationCost

No	*Transportation Cost*	*Number*	*Percentage*
1	< Rp 50.000,-	89	28,71
2	Rp 50.000,- s/d Rp 250.000,-	137	44,19
3	Rp 250.000,- s/d Rp 500.000	45	14,52
4	> Rp 500.000,-	39	12,58
Total		310	100

Based on the results of data processing as shown in the **Table 4**, **Table 5**, **Table 6** and **Table 7**, it can be concluded that the level of most trips by purpose of travel is to shop, amounting to 36.13%. The most widely used modes for traveling is a boat/speedboat. This is because since the area to be achieved to cross the river/sea first. While the level of daily travel and transportation expenses incurred for each trip is the first time (roundtrip) amounted to 52.58% and 50.000, - up to Rp 250,000, - by 44.19%.

The Potential of The Region

Fig. 1 The Distribution of basic food and fuel oil in Nunukan Regency

From the Fig. 1 can be seen that the distribution of basic food and fuel oil in Nunukan Regency concentrated in Sub Krayan (Long Bawan), District of South Krayan (Long Layu), Binter, Mansalong, Sekaduyan Taka, Nunukan and Sei.Pancang. As for the distribution of basic food in Nunukan, centered in the city of Tarakan which is then distributed to Long Bawan, Long Layu, and then distributed to the South Nunukan.

The Road Network Development Scenarios

Alternative policy proposal and management of road network development that need to be done, include:

1. Alternative 1 (Do Nothing), Road Maintenance
   Development and management of the road network in the first alternative is based on the existing condition of the existing road conditions, based on the condition of the road network and road repair/maintenance of roads only.
2. Alternative 2 (Do Something), the construction of new roads and upgrading of roads (New Road Construction). Development and management of the road network this alternative 2, based on:

a. Development of road network based on the needs of the community.
b. Road Network Development Direction based policies / legislation.
c. Development of Road Network based Support Funding.

One of the key elements in implementing transportation is the availability of good road network infrastructure and meet the development of the movement of people and goods, especially in Nunukan Regency. Nunukan Regency as a District municipality in the province of North Kalimantan Province currently has a network of road infrastructure that hasn't been fullest to meet the movement of people and goods, especially in the border region, so that the limitations of the existing road network in compare with the growth in traffic that continues to experience significant increases cause a variety of problems. For the development and management of the road network alternative 2, the construction of new roads and the improvement of the road (New Road Construction). The construction of new roads and improvement of existing roads can be seen in the **Fig. 2** and **Fig. 3**.

Fig. 2. Road Network Map of Nunukan Regency

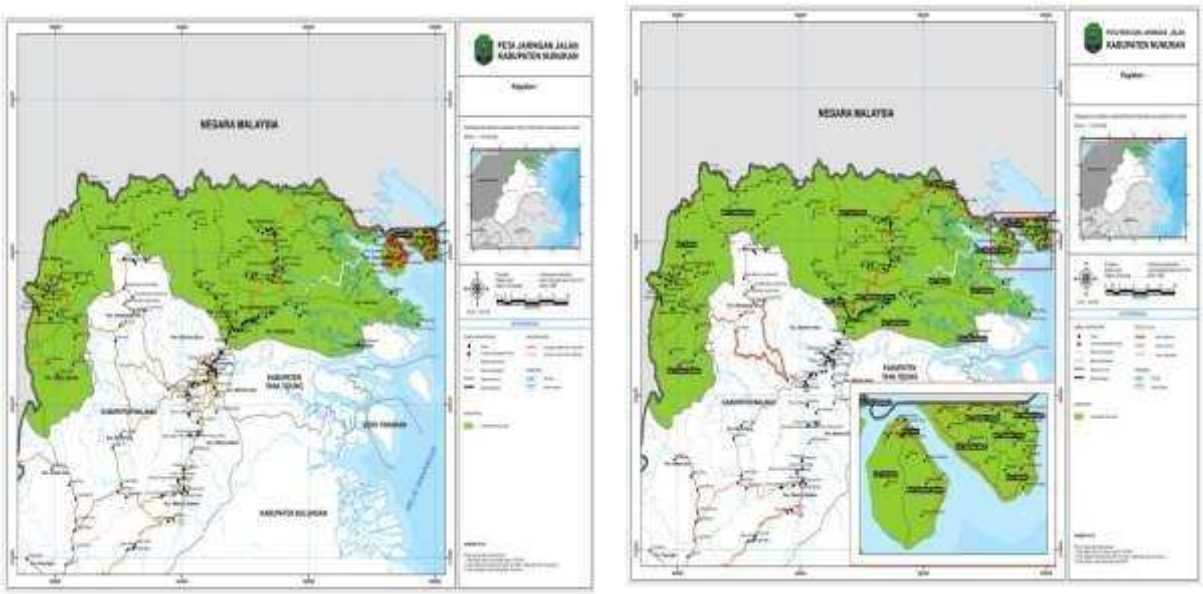

Fig. 3. Road Network MapPlan of Nunukan Regency

Status, Function and Roads Class The condition of network roads system hierarchy data in Nunukan Regency can be seen in the **Table 8.**

Table 8. Status, Function and Class of Roads in Nunukan Regency

No	*Roads*	*Road Function*	*Road Class*	*Road Status*
1.	Mensalong – Simpang Tiga Apas	The Primary Arteri	I	National
2.	Simpang Tiga Apas – Simanggaris	The Primary Arteri	I	National
3.	Simanggaris – Sei ular	The Primary Arteri	I	National
4.	Simanggaris – Batas Negara	The Primary Arteri	I	National
5.	Pa'Padni – Pa'Betung – Longa Api	Collector	IIB	Regency
6.	Long Api - Pa'Kebunan – Pa'Raye	Collector	IIB	Regency
7.	Long Api – Long Bawan – Terang Baru	Collector	IIB	Regency
8.	Long Bawan – Buduk Tumu	Collector	IIB	Regency
9.	Long Bawan – Long Nawang – Lembudud	Collector	IIB	Regency
10.	Long Nawang – Lembudud	Collector	IIB	Regency
11.	Lembudud – Long Layu – Long Rungan – Long Padi – Ba'Lihau	Collector	IIB	Regency
12.	Ba'liku – Binuan – Pa'kebuan	Collector	IIB	Regency
13.	Pa'Kebuan – Wa yagung	Collector	IIB	Regency
14.	Kecamatan Nunukan	Collector	IIA	Province
15.	Kecamatan Nunukan Selatan	Collector	IIA	Province
16.	Kecamatan Sebatik	Collector	IIA	Province
17.	Kecamatan Sebatik Barat	Collector	IIA	Province
18.	Kecamatan Sebatik Tengah	Collector	IIA	Province
19.	Kecamatan Sebatik Utara	Collector	IIA	Province
20.	Kecamatan Sebatik Timur	Collector	IIA	Province

Annual Program Priorities

The Priority Programme Annual Nunukan :

1. Increased accessibility and the construction of road networks in the border region of North Borneo.
   a. Objective: To improve the accessibility of the region
   b. Target: Improved accessibility of road network with the aim to further boost the economy and provide a better service to the public evenly
   c. Forms Activities: Conducting new road construction, road maintenance, road widening, improved quality, routine and periodic maintenance

2. Bridge Improvement Program
   a. Objective: To improve the accessibility
   b. Goal: Increasing the accessibility of the bridge with the aim to better connect villages connected
   c. Activities shape: Doing construction of new bridges, bridge repair, improved quality, routine and periodic maintenance

IV. Conclusions and Recommendations

After the collection, processing and analysis of data obtained from the field survey, the results are scripted on the map the development of the road network in Nunukan. This scenario is based on the development of the road network on the needs of the community, policy/legislation, and funding support. Road network development scenario chosen is the alternative scenario 2 (construction of new roads and the upgrading of roads / Road New Construction). This road network development scenario chosen, because the existing condition of the existing road network in Nunukan is not maximized.

To realize these scenarios need to be prepared strategy action plan systematic, logical, conducive, socialized periodic and continuous as it does an annual program priorities Medium Term and Long-Term :

1. Road Network Development Program in Nunukan
2. Bridge improvement program
3. Terminal development and service in Nunukan
4. Route network planning.
5. Preparation of road network information system / trajectory.
6. Determination of the causeway transport network

References

[1]. Dep. PU, 1997, Manual Kapasitas JalanIndonesia (MKJI), Departemen Pekerjaan Umum Direktorat Jenderal Bina Marga, Jakarta.
[2]. Bappeda Nunukan, 2010, Rencana Strategis Badan Perencanaan Pembangunan Daerah Kabupaten Nunukan Tahun 2011 -2016, Badan Perencanaan Pembangunan Daerah. Nunukan.
[3]. Pemda Nunukan, 2010, RPJMD Kabupaten Nunukan 2011 – 2016, Nunukan.
[4]. Pemda Nunukan, 2010, Rencana Pembangunan Jangka Panjang Pemerintah Kabupaten Nunukan 2005 – 2025, Nunukan.
[5]. Pemda Nunukan, 2010, Rencana Tata Ruang Wilayah Kabupaten Nunukan Tahun 2013 – 2033, Pemerintah Kabupaten Nunukan, Nunukan.
[6]. Dinas Kebudayaan Pariwisata dan Olahraga, 2010, Rencana Strategis Dinas Kebudayaan Pariwisata Pemuda dan Olahraga Tahun 2011 – 2016, Dinas Kebudayaan Pariwisata dan Olahraga, Nunukan.
[7]. Dinas Pertanian Tanaman Pangan dan Olahraga, 2010; Rencana Strategis Dinas Pertanian, Tanaman Pangan dan Peternakan; Dinas Pertanian Tanaman Pangan dan Olahraga, Nunukan.
[8]. Pemda Nunukan, 2013, Laporan Akuntabilitas Kinerja Instansi Pemerintah, LAKIP Kabupaten Nunukan, Nunukan.