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## *Experimental Study on the effect of Non-Uniform Sediment Particle on Delta Progression in Reservoir*

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### **ABSTRACT**

The coarser particles deposit gradually and form a Delta at the upstream of the reservoir that extends further downstream towards the dam. In this research, the effect of non-uniform sediment particles has been studied on the Delta progression in the reservoir in a physical model. Ten types of grading curves were used. All of the curves were the same in mean diameter and they have normal distribution. In this research, the effect of non-uniform particles on Delta progression was investigated using a physical model. In this model, the river was connected to the reservoir by a gradual transition. Based on the experimental observations, in the range of this study velocity of Delta progression decreased with increasing of non-uniform particle and time of progression increased. In the range of geometric standard deviation 1 to 2 the effect of non-uniform particle was not tangible but with increasing of geometric standard deviation the effect of non-uniform particle on Delta progression observed. Based on the experimental observations, slope of foreset decreased with increasing of non-uniform particle.

### **KEYWORDS:**

Experimental Study, Delta Progression, Non-Uniform Sediment Particle

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### 1- INTRODUCTION

Coarse grain sediments (in bed load aggregation form) are deposited upstream of the reservoir and constitute Delta (Fan and Morris, 1992). a sudden shift of slop is observed in upper part and foreset of deltaic sedimentation. Also a difference of graining was spotted between the topset and foreset of Delta. Various factors are effective in deltaic sedimentation process within the reservoir. Some of these parameters were studied in previous researches (Voller et. al, 2004) (Kostic and Parker,2003). One of the important factors in deltaic sedimentation formation is the grading curve of the sediment particles that is definitely effective in formation and progression of Delta in a reservoir.

### 2- METHODOLOGY

To perform the experiments, an experimental river-reservoir model with overall length of 15m was used which consisted of a river part and a reservoir part with 5m and 10m length respectively. The sediment load was injected into the river part of the model using an automatic injector unit. We used a regulated weir for water level control and ultrasonic device for flow measurement. This ultrasonic device was on the pumping system pipe. Properties of grading curves are shown in Table 1. In each experiment, progression of top and toe and longitudinal profiles were recorded. In Table 1  $d_m$  is mean diameter,  $G$  is geometric standard deviation,  $C_c$  is grading factor.

**Table 1. Various grading curves properties**

code.	$d_m$ (mm)	$G$	$C_c$
1	1.4	1.2	0.99
2	1.4	1.4	0.98
3	1.4	1.6	0.97
4	1.4	1.4	0.97
5	1.4	2	0.97
6	1.4	2.1	0.98
7	1.4	2.3	0.99
8	1.4	2.4	0.97
9	1.4	2.5	0.99
10	1.4	2.6	0.99

### 3- CONCLUSIONS

Non-uniform sediment particles are effective on both the exponent and coefficient of the relationship and reduction of delta progression rate is seen with

increasing the non-uniformity of sediment particles.

Considering the average exponent of 0.646 in case of using uniform particles the efficacy for the geometric standard deviation of greater than 2 is involved as a coefficient in the exponent of the relationship that is shown in the following relationship:

$$X^* = A.T^{*C_t.B} \tag{1}$$

Where  $B$  is the exponent of the relationship in case of using uniform particles (geometric standard deviation less than 2) and  $C_t$  is the effect of non-uniformity of particles on the exponent of the relationship. The relationship of this coefficient with geometric standard deviation of particles is presented in Eq.2.

$$C_{t_{TOE}} = 0.461\sigma + 0.0966 \tag{2}$$

Considering the average value of 0.81 for uniform particles the same as toe, Eq.3 will be extracted for  $C_t$  coefficient of the top.

$$C_{t_{TOP}} = 0.551\sigma - 0.131 \tag{3}$$

But it should be noted that popularization of the relationships for the whole length of the reservoir is not correct, and due to the effect of non-uniformity of particles on the coefficient and exponent of the power relationship of the delta progression investigation and extraction of the relationships in various parts of the reservoir is needed. The first conclusion given from this study is undeniable effect of non-uniformity of particles on delta progression in reservoir. In previous researches about Delta progression in reservoir no parameter related to the non-uniformity of sediment particles was entered in dimensional analysis and somehow all the relationships of delta progression in reservoir need corrective coefficients related to the non-uniformity of sediment particles. In this research, these corrective coefficients in the range of 12% of the reservoir total length are presented. Another parameter that is effective on delta progression in reservoir is the angle of Delta foreset, and this angle is effective on the time progression of top and toe of delta, as this angle increases more differences is seen between the time progression of top and toe of delta.

Delta foreset slope decreased with increasing in non-uniformity of sediment particles, and there is a linear relationship with suitable correlation between variation of geometric standard deviation and uniformity coefficient with slope of Delta foreset. In other words, when the non-uniformity of sediment particles increases in reservoir, rate of toe progression related to top of delta will increase due to the reduction

of angle of slope. The relationship between slope of foreset and G are shown in Figure 1.

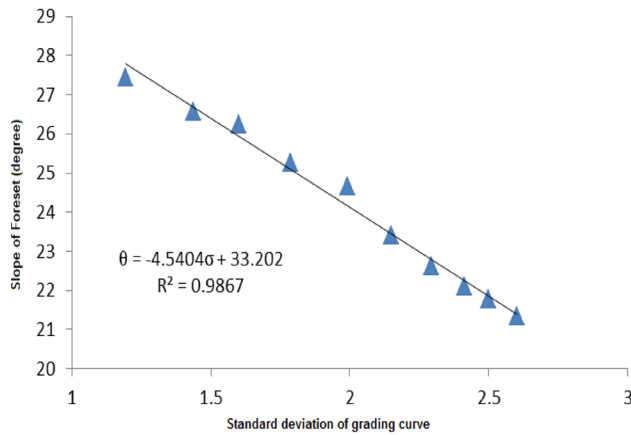


Figure 1: Relationship between slope of foreset and G

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