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Evaluation of the Fluid Loss Property of *Annona muricata* and *Carica papaya*

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Abstract

This technical paper evaluates the fluid loss property of *Annona muricata* and *Carica papaya*, prepared and measured as per API standard. This is a laboratory measurements carried out using low temperature and low pressure filter press. The prepared fluids were supplemented with 2 ppb XCD polymer product to enhance their carrying capacity. Their characteristics and commercial availabilities were also investigated. The 30 minutes filtrate volumes at 5 ppb, 10 ppb, 15 ppb and 20 ppb were obtained. The graph of concentrations versus the volume of the filtrate obtained was plotted. It was discovered that the concentration increases with decrease in volume of fluid loss and impermeable filtered mud cake was also obtained. Though, both gave good results, but the results of *Annona muricata* under the same conditions and concentrations were better than that of *Carica papaya*.

Keywords

Annona muricata, Carica papaya, Fluid Loss, Concentrations

1. Introduction

Generally, not much attention has been paid to the development of drilling fluids from biomaterial that has good filtration volume, impermeable filtered mud cake, cost effective, availability and environmentally friendly. In order to enhance the usage of drilling fluids, fluid loss additives were introduced and their design changed to have common characteristic features that aid in safe, economic and satisfactory completion of a well. In addition, drilling fluid loss additives are also required to perform the following functions: minimize reservoir damage; seal the formation pores by forming low-permeability filter cake to prevent inflow of formation fluids into the well; have minimum negative impact to the environment; aid in collection and interpretation of data available through drill cuttings, cores and electrical logs; provide frictionless environment between the drilling string and the sides of the hole; minimize any damaging effect on the sub-surface equipment and piping. Drilling fluids are designed to build a filter cake. The filter cake is intended to reduce filtrate loss to the formation, and give a thin impermeable mud cake at wall of the wellbore. Two components of the drilling fluid are specifically designed to assist in the development of a desirable filter cake are: blinding particles which have a specific size range to create a solid framework for the filter cake; fluid loss additives which are designed to create deformable particles to fill small gaps and improve the seal.

1.1. Fluid Loss Property of a Drill Fluid

Fluid loss determines the filtration performance of the mud or in other words while drilling through permeable formation, and a part of fluid is filtered into the formation leaving behind a mud cake. The thickness and permeable of oil mud cake is dependent on the rate of filtration and the type of particles forming the mud cake [1].

1.2. Filtration Theory

For the occurrence of filtration, three conditions are required [2]:

1) A liquid or a liquid/solids slurry fluid must be present.

2) A permeable medium must be present.

3) The fluid must be at a higher pressure than the permeable medium.

For the occurrence of fluid loss, there must be liquid and solids existing together as drilling mud; permeable medium must be present and there must be pressure differential from the wellbore to the reservoir. If any of the above condition is invalid, filtration of the drilling fluid will not occur.

There are two types of fluid loss laboratory measurements: Static test, normally called low temperature low pressure, also referred to as "API filtration test" which is the type of test applied to *Annona maricata* and *Carica papaya* water based fluid under 100 psi and ambient temperature. We also have dynamic test, this is the type of test carried out at the differential pressure of 500 psi and the temperature of 250˚F. Static test does not accurately stimulate down hole conditions because only static is being measured. In the wellbore, filtration is occurring under dynamic conditions with the mud flowing past the wall of the hole. The tests depend on Darcy's law, which is the flow of fluids through permeable materials (sand, sandstone, mud filter cake). It can be used to relate filtration rate to permeability, cross sectional area, differential pressure, viscosity and filter cake thickness as shown in Equation (1).

$$q = (kA\Delta P)/(\mu h) \tag{1}$$

where:

q = Filtrate flow rate, cm^3.

k = Permeability, darcies.

A = Cross-sectional Area, cm^2.

ΔP = Differential Pressure, atm.

μ = Viscosity, cP.

h = Thickness of filter cake, cm.

As this equation illustrates, with some assumptions of fluid flow through a permeable medium, the fluid must be incompressible, with a constant density in the flow system and the flow is also assumed to be linear. Also, fluid loss is lower with lower filter cake permeability, smaller area and lower differential pressure. From Equation (1), it is shown that filtration decreases with increasing filtrate viscosity and increasing filter cake thickness, if the thicker filter cake has the same permeability.

2. Literature Review

A model oil well was used to simulate filtration under different bottom hole geometry and hydrodynamic conditions [3]. They established three classes of filtration: Static filtration, dynamic filtration and filtration from beneath the bit during drilling. An analytic approach was presented to the filtration theory [4]. He described the mechanisms of filtration by a theoretical-empirical non-linear equation which was linearized and solved explicitly under certain conditions. The study demonstrated the effects of mud properties like viscosity and filtration rate with a major conclusion that several qualities that affect dynamic filtration have no counterpart in static filtration. Effectiveness of commercial fluid-loss control agents in dynamic filtration experiments with clay/water mud was studied [5]. Results found the starch and viscosity reducers to be most cost effective because of its low filtrate volume and impermeable filtered mud cake. Improvement in average cake resistance values using the concept of filtration permeation was suggested [6].

2.1. Characterization of *Annona muricata* (Soursop)

Annona muricata trees are widespread in the tropics and frost-tree subtropics of the world [7] [8]. It is usually grown from seeds which can be stored for several months before planting. Germination of seeds usually takes 3 weeks, but under some optimal conditions can be delayed for up to 2~3 months. Alternatively, propagation of the *Annona* species is achieved by cuttings for rapid multiplication of new genotypes. The soursop tree produces dark green, spiny aggregate fruits made up of berries fused together with associated flower parts [9]. The fruit pulp consists of white fibrous juicy segments surrounding an elongated receptacle [10]. The fiber content of soursop pulp was reported as 0.78% [11], 0.95% [12]. **Table 1** shows the nutrientsanalysis of *Annona muricata*.

2.2. Characterization of *Carica papaya* (Pawpaw)

Papaya is the widely cultivated and a tropical fruit tree. Most *papaya* are single stem trees whose height ranges from about 3.66 m to 9.14 m. Their leaves are arranged and confined to the upper most part of the trunk. The fruits are either

Table 1. Centesimal Composition of *Annona muricata* Edible Portion of *Annona muricata* made in El Salvador [13].

Moisture/%	Protein/%	Fat/%	Fiber/%	Calcium/%	Phosphorus/%
97.52	0.58	0.21	1.68	0.00041	0.00067
Iron/%	Carotene/%	Thiamine/%	Riboflavin/%	Niacin/%	Ascobic Acid/%
0.0009	0.000014	0.0003	0.00038	0.0028	0.018

spherical or spindle in shape. All parts of the plant contain latex in articulated laticifers [14]. The flowers are sweet-scented, open at night and are moth-pollinated [14]. The fruit is a large berry about 14.99~44.96 cm long and 9.91~29.97 cm in diameter. **Table 2** below shows the nutrients analysis of papaya.

Table 2. Centesimal Composition of Edible Portion of *Carica papaya* made in Malaya [15].

	Calories/%	Moisture/%	Protein/%	Fat/%	Carbohydrates/%	Crude Fiber/%
Fruit	23.1~25.8	85.9~92.6	0.081~0.34	0.05~0.96	6.17~6.75	0.5~1.3
Leaves	—	83.3	5.6	0.4	8.3	1

	Ash/%	Calcium/%	Phosphorus/%	Iron/%
Fruit	0.31~0.66	0.0129~0.0408	0.0053~0.022	0.00025~0.00078
Leaves	1.4	0.406(CO)	—	0.00636

	Carotene/%	Thiamine/%	Riboflavin/%	Niacin/%
Fruit	0.0000045~0.000676	0.000021~0.000036	0.000024~0.000058	0.227~0.555
Leaves	—	—	—	—

	Ascorbic Acid/%	Tryptophan/%	Methionine/%	Lysine/%	Magnesium/%	Phosphoric Acid/%
Fruit	0.035.5~0.071.3	0.004~0.005	0.00	0.015~0.016	—	—
Leaves	38.6	—	—	—	0.035	0.225

From **Table 1** and **Table 2**, *Annona muricata* has 1.68% fiber content while *Carica papaya* has between 0.5%~1.3% of fiber content. This makes them suitable as fluid loss control additives. *Annona muricata* and *Carica papaya* are good biomaterial drilling fluid loss additives that are also environmentally friendly. The only short comings are their non-applicability to drill high temperature wells and easily to be attacked by bacteria.

3. Methodology

The materials involved in the laboratory measurements are unripe *Annona muricata* and *Carica papaya*. Low temperature and low pressure filter press was used for the measurements. The fresh and unripe *Annona muricata* and *Carica papaya* were sliced into pieces, dried in the oven for 6 hrs at the temperature of 45˚C which is the optimum temperature of retaining the chemical property of the additives. This can also be dried under the sun provided that the optimum that is not exceeded. Both were grinded differently into powder form, sieved and regrinded until finer powder were recovered.

Mud Formulations/Experimental Procedure

Four sets of measurements using 5 ppb, 10 ppb, 15 ppb and 20 ppb for both *Annona muricata* and *Carica papaya* were added to fresh water, each sample was supplemented with 2 ppb of XCD polymer to aid the carrying capacity and to prevent settling. API fluid loss measurements were carried for each formulation, for the two local materials. The filtrate then obtained and their results were shown in Table 3 below.

Table 3. Filtrate volume at various material concentrations.

Material Concentrations /ppb			*Annona muricata*		*Carica papaya*	
Annona muricata	*Carica papaya*	XCD Polymer	Filtrate Volume/ ml	Cake Thickness/ inch	Filtrate Volume (ml)	Cake Thickness/ inch
5	5	2	24	1/32nd	30	1/32nd
10	10	2	16	2/32nd	20	1/32nd
15	15	2	12.4	2/32nd	16	2/32nd
20	20	2	9.2	2/32nd	11	2/32nd

4. Results and Discussion

Evaluation on the suitability of *Annona muricata* and *Carica papaya* as fluid loss control additives in drilling mud were carried out as per API standard. Their results were shown in both Table 3 and Figure 1.

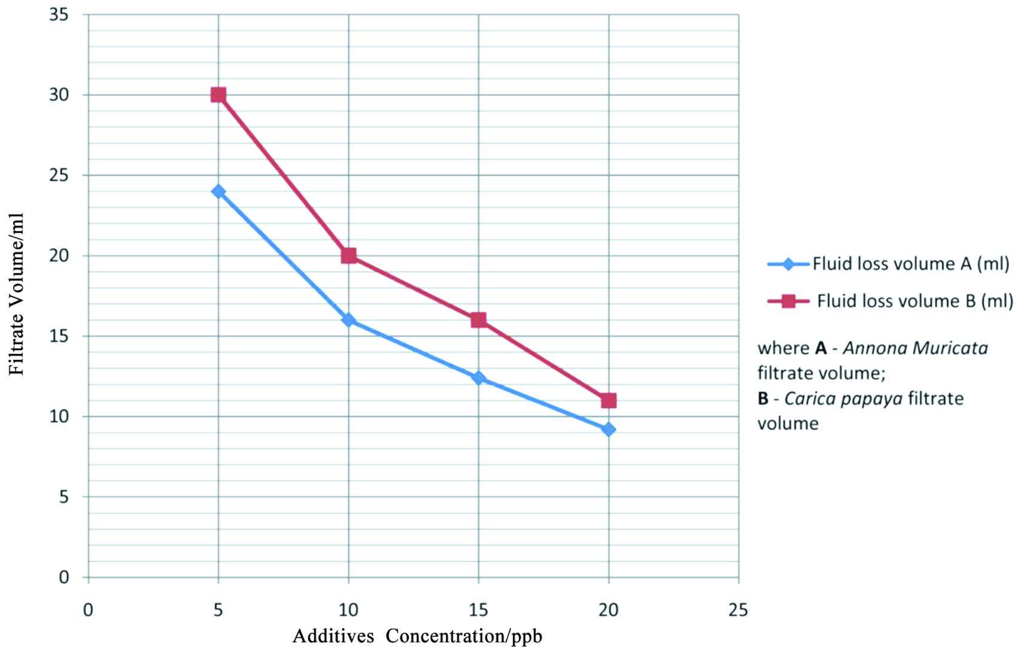

Figure 1. Effect of Increase in Concentrations on *Annona muricata* and *Carica papaya.*

From Figure 1, it is shown that increase in concentrations of both *Annona muricata* and *Carica papaya* decreased the filtrate volume. At the concentration of 10 ppb, *Annona muricata* and *Carica papaya* gave the filtrate volume of 16 ml and 20 ml respectively. This is comparable with the work done by [16], in whose work, 10.5 g of bentonite was added in 350 ml of fresh water. Agitation was allowed for 30 mins and low temperature and low pressure fluid loss was then carried out. The API fluid loss test carried out on this mixture indicates that the bentonite does not do too badly in retaining its fluid content at 26.5 ml. The filtrate volume obtained from *Annona muricata* and *Carica papaya* results were comparable to [17], they carried out two sets of measurements with pleurotus mud with the compositions 350 ml fresh water, 0.25 g Caustic soda, 20 g Potassium Chloride, 1 g XCD polymer, 75.4 g barite and polypac mud with the compositions 350 ml of fresh water, 0.25 g Caustic soda, 20 g Potassium chloride, 1 g XCD polymer, 75.4 g barite. They results of the two sets of tests gave 8 ml and 5 ml respectively. This therefore shows that both *Annona muricata* and *Carica papaya* gave good results. Although, at equal concentrations, *Annona muricata* gave a better result than *Carica papaya*. From Figure 1, it also shows that the higher the concentration, the lower the filtrate volume and that is one of the major qualities of a good drilling fluid additive. Based on the result of the filtrate volume obtained, *Annona muricata* is more suitable as a fluid loss additive than *Carica papaya*. It is also very important to mention that under field condition, after about 2 to 3 bottoms up, when much shearing has taken place, the results in Figure 1 should show a greater improvement in terms of fluid loss.

5. Conclusion

In conclusion, both un-ripe *Annona muricata* and *Carica papaya* are suitable as a fluid loss additives for water base fluid, although the result obtained from un-ripe *Annona muricata* is better than that of *Carica papaya*.

6. Contribution to Knowledge

The degree of suitability of both *Annona muricata* and *Carica papaya* as water base drilling fluids additives per concentration using low temperature and low pressure filter press was established.

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