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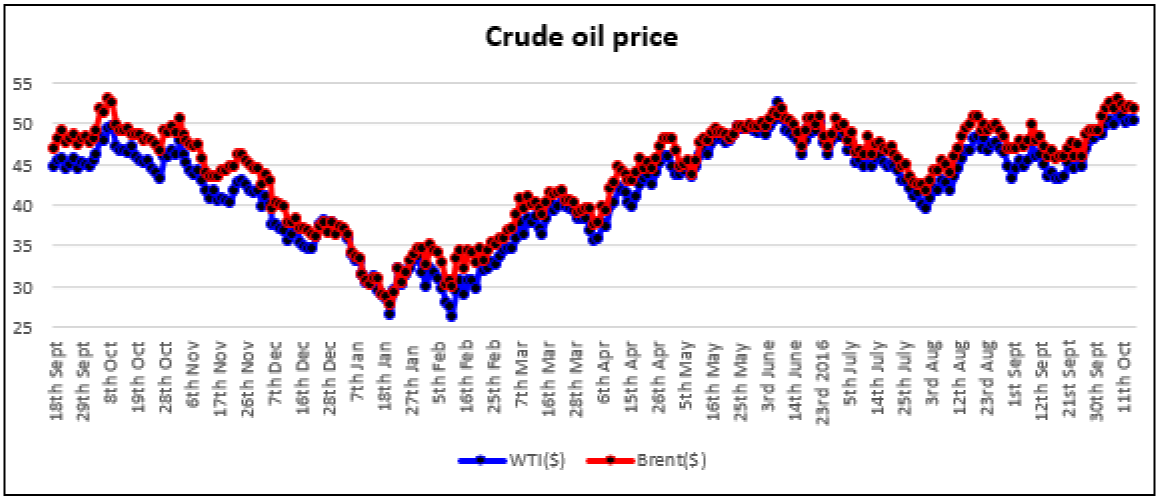
Some of the news items for this week are as follows:



- Crude oil prices climbed above $50 a barrel as a result of OPEC's decision to limit production, a decision expected at their next meeting on November 30th in Vienna. This has also resulted in some activity amongst the US shale producers. The rig count in the US rose by 3 to 428, which is the highest since February this year.

- According to EIA, the crude production in the US fell by 30,000 b/d last week to 8.47 mb/d.

- The crude price of $50 may not be sustainable for many US shale producers, who have started looking for the price to go up to $60, when they can find the production to become commercially viable. This can result in the production going up 1 mb/d by the end of 2017 or early 2018.

- In the last one year, the US crude production reduced from 9.42 mb/d to 8.43 mb/d.

- Apparently, OPEC has some internal differences in the production outputs for September 2016 of some of its members. Venezuela and Iraq's production figures were higher by some 565,000 b/d than the estimates OPEC compiled from secondary sources. These differences will need to be resolved before caps on production are set for each member in November. Such differences may crop up for some other members also as not all of them have submitted their production figures yet. OPEC certainly has some homework to carry out.

- The crude oil production by Libya is set to increase by December, when fields restart and ports reopen. Libya's output now is 540,000 b/d which is expected to increase to 900,000 b/d before the end of 2017. The country's production was 1.6 mb/d before the 2011 uprising that ousted the longtime leader Qadaffi.

- Speaking at the World Energy Congress in Istanbul on Monday this week, the Russian President Vladimir Putin had commented that his country will cooperate with OPEC in their efforts to limit crude oil production. Roseneft and Lukeoil, Russia's two big companies have also commented that all Russian companies will comply with any decision taken by their country.

- According to IEA, if OPEC is able to honour its decision of limiting its production between 32.5 and 33 mb/d in November, the oil supply and demand may balance earlier than expected. But if the price of the barrel reaches $60 as a result, US shale production will go up, which might again add more oil in the market. In all likelihood, we may see some increase in production from Libya and Nigeria also. Some analysts are estimating that the crude oil production may go up to $70 a barrel.

- Saudi Arabia has crude reserves of 266.5 billion barrels, which it estimates will last for another 70 years.

- As a result of reduced levels of activity, EMGS is seeking a global reduction in employee expenses by 20% by way of temporary or permanent layoffs.

So much for the industry news this week.

For the lighter side this week

Have you ever wondered why golf balls are dimpled?

In our physics class in college, we learnt in the chapter on projectile motion, that if an object such as a cannon ball is projected at an angle of 45^o, it travels the maximum distance. In the case of a golf ball, we would expect that when a golfer hits it at 45^o, it would travel the maximum distance. It turns out that it is not strictly true. If a smooth golf ball were hit by a professional golfer at 45^o, it would travel only half the distance as a similar dimpled golf ball. So how do dimples help the golf ball travel longer distances? And how many dimples are there on each golf ball? This is interesting stuff.

When a golf ball is hit with a golf club, the contact between the club and the ball is just a minute fraction of a second, during which the ball is sent flying in a *specific direction* at a *large velocity*, as it is launched at a *given angle*, and with a given *spin rate*. Once the ball is in the air, the motion of the golf ball is controlled by gravity and aerodynamics.

We know from our experience of riding a bike that when we are travelling against the wind, there is high air pressure on our chests, which resists our motion. But the speed of a bike that we ride is small compared with the speed of a car. For minimizing the head on pressure of the air, racing cars have specific snooty shapes. For objects travelling in air, the airplanes for example, the aerodynamics is different than a body travelling on the ground. It so happens that an object travelling in the air experiences a force opposing its motion (called drag) and another force perpendicular to its motion (called lift). You may know that when you move your hand out of a moving car or bus, it experiences differing forces, which are simply a variation of the lift and drag acting on your hand. For an airplane, the air flowing over its wings is forced downwards, causing it to rise. And the somewhat pointed shape of the airplane in the front reduces the drag or resistance as it moves forward.

In the case of a golf ball, if it were not dimpled, as it moves forward, the air that comes into contact with the front of the ball separates out at almost the vertical hemispherical boundary, as it moves to the backside, and creates a wider low-pressure area there, which implies higher drag. With a dimpled golf ball, the airflow changes significantly, as the incoming air interacts with the dimples and creates some turbulence; and because of this the air separates out much further than the vertical hemispherical boundary, and thus creates a smaller drag. For this reason, a dimpled golf ball travels longer distances than a smooth golf ball.

Besides travelling longer distances, a dimpled golf ball also gains more lift. This is because as it is hit with a club, it is sent into the air spinning at high speed. The spin on the ball changes the air interaction with the dimple above and below the dimpled ball in motion.

Let us take the case of a smooth golf ball that is travelling from right to left at 250 kilometers per hour (km.p.h.), and is not spinning. So the air would be travelling from left to right above and below the golf ball at the same rate. Now suppose the golf ball is dimpled and is spinning. As explained above, the dimples tend to make the air travel beyond the top and bottom, and 'stick' to the ball for longer. But the spin on the ball tends to slow the air particles close to the ball at the bottom, and tends to speed up the air particles close to the top of the ball. This difference in the speed of air above and below results in a differential pressure that provides the golf ball a lift.

When we understand this, a question that pops up in our mind is, how did the golfers conceive of the dimple idea, and what would be the most optimum design of a golf ball in terms of the number of dimples, and their depression?

These are interesting aspects. Let's begin with the historical one. Back in the 17^{th} century, people played golf with wooden balls. These wooden balls made way for balls made of leather pouches packed tightly with feathers. Thereafter, it was noticed that a used ball that is abraded and scuffed, travelled longer distances than a new golf ball. This led to the idea of making dimples on the surface of the ball.

Typically, there are between 300 and 500 dimples on a golf ball, the number varying with the manufacturer. The depth of each dimple is about 2.5mm, and their shape traditionally has been spherical. But hexagonal dimples are also in use. Manufacturers spend researching on the most optimum design in terms of the above variables, and hence the variation talked about.

These days computer models have been constructed that solve aerodynamic equations and entail billions of points on the golf ball surface and design simulations are carried out on supercomputers. There is huge variety of patterns with many parameter variations. So, it may be possible to arrive at a better pattern, rather than the most optimum patter or design for a golf ball.

These were some very interesting questions for me, and I enjoyed finding answers to them.

I hope you will find them interesting too.

Did you know?

… who invented scissors?

The scissors that we see today, made out of two pieces of metal attached at a pivot point was invented by the famous painter Leonardo DaVinci, who is known well for his Mona Lisa painting.

An earlier form of scissors made out of a single piece of metal, bent and sharpened at both ends was invented in 1500 BC in ancient Egypt.

So much for this week! Till the next post, stay safe and happy!