What is the Difference in BOD, BOD5, C-BOD and N-BOD, I Am So confused, & I thought there was only one way to measure BOD?

BOD technically stands for Biological Oxygen Demand

BOD5 means the test has been run for 5 days.

C-BOD means only the Carbonaceous Biochemical Oxygen Demand

N-BOD means Nitrogenous Biochemical Oxygen Demand

BOD5 typically includes C-BOD and N-BOD unless one or the other is inhibited.

What are the main differences of C-BOD vs. BOD5? There are too many terms and it is getting confusing to me. . . . . There are two completely different tests-a C-BOD test and a BOD5 test. Many times a C-BOD vs. BOD5 test is needed due to conditions at a plant. In some places where the nitrification of ammonia may not be complete (i.e., incomplete conversion of ammonia (NH3) to nitrate (NO3)) or where too high levels of amines or ammonia are present, false BOD readings may occur. This can occur in municipal lagoons, chemical plants or refineries. For lagoon (pond) treatment systems or other situations where this may occur, it is recommended that a Carbonaceous Biochemical Oxygen Demand (CBOD or Inhibited BOD) should be reported and used in place of 5-day Biochemical Oxygen Demand (BOD5). A special chemical is added to kill the autotrophic bacteria so Nitrification is inhibited so that only the oxidation of COD occurs.

The biochemical oxygen demand (BOD) test tries to closely model an aerobic wastewater treatment system and the natural aquatic ecosystem. It measures oxygen taken up by the bacteria during the oxidation of organic matter. The test usually runs for a five-day period, but can run 7 or 10 days as well, depending on specific sample circumstances.

This conversion of carbon to cells is the synthesis reaction requiring about 0.5 to 0.6 lb O2/lbBOD (KgO2/Kg BOD). If the process is continued, a second oxygen demand is exerted for oxidizing the cells or digesting (stabilizing) the cells. This second phase is endogenous respiration, and requires an additional 0.8 to 0.9 lb O2/lb BOD (Kg/Kg). Pounds (kg) total oxygen required for carbonaceous BOD removal can range from 0.7lb/lb (kg/kg) BOD for high rate activated sludge with short detention of Biomass (low sludge age) up to 1.5 lb/lb (kg/kg) BOD for extended aeration with long detention of Biomass (MLSS, i.e., (long sludge age) in the bio system.

N-BOD means Nitrogenous Biochemical Oxygen Demand - All forms of 'reactive nitrogen' in urine and proteins (urea, uric acids, ammonia, amino acids, nitrates) are nutrients for algae and aquatic plant growth.
The nitrogenous waste in municipal and industrial sewage is used by autotrophic bacteria and they use a significant amount of oxygen as an energy source and convert ammonia to nitrates.
This phenomenon is called N-BOD or Nitrogenous Biochemical Oxygen Demand. The nutrient enrichment 'pollution' contributes to the eutrophication of lakes, rivers and water bodies when discharged in a final effluent.

The TKN (Total Kjeldahl Nitrogen) test measures the amount of reactive nitrogen (ammonia and organic nitrogen) in the sample that can be used by autotrophic bacteria and when they do, require oxygen, thus exerting a N-BOD, which would be equal to 4.6 x TKN mg/l.

Theoretically you can calculate Total Biological Oxygen Demand of any influent = 1.5 x BOD5 + 4.6 x TKN.

While Carbonaceous BOD theoretically should require ~1.5 parts of O2 per part of BOD to be removed, nitrogenous BOD is significantly higher.
For nitrogenous BOD the demand for oxygen is 4.6 lb O2/ lb BOD (4.6Kg/Kg) removed. To achieve nitrogenous conversion of ammonia to nitrate requires longer aeration time with low food to microorganism ratio, i.e., much sludge MLSS (M) with low food supply (F). This condition results in a long sludge age, which promotes nitrification.

Here is a math example of the Total Biological Oxygen Demand:
What are the oxygen depletion 'pollution' values of raw sewage and what are the treatment efficiencies of different sewage treatment plants.

Raw municipal sewage commonly has the following values:
BOD5 = 200 mg/l (still assumed to be C-BOD5)
TKN = 40 mg/l.
Total BOD = 1.5 x BOD5 + 4.6 x TKN = 300 + 184 = 484 mg/l

How you run your tests, how quickly you run your tests, if you have algae in the sample, if you use correct seed vs. plant MLSS can all impact the test results.

Wait a minute slow down. Why should all those factors make a big difference?
Let's take one at a time. If you pull a sample and send it off to a lab and it takes overnight, you already will have a lower BOD in your bottle. The bacteria in the sample bottle will grow. Your bottle is not sterilized. Most of the facultative bacteria that degrade the carbon compounds in the system have a life span of twenty minutes to two hours. If your sample is shipped off to an outside lab and the test is not run immediately, the real results will be lower since degradation will have occurred in the bottle. Endogenous respiration may take up more oxygen than the initial degradation of the carbons you are trying to measure. Another thing to consider, if the sample sits too long and goes septic, there may be a false higher oxygen demand.

Algae in a sample can give a false BOD reading. It will die off in the bottle, re-release some of the BOD and give a higher reading than was initially present.

What type of seed are you using to run the BOD test? Some plants use a prepared BOD seed tablet.
Many plants use their own MLSS when running a BOD test onsite.
The problem with this is standardization. What if you have a ton of filaments in your MLSS at a given point. You are using 1-2 mls of MLSS in your testing. In reality you are only getting so many active bacteria that will grow in your BOD testing. What if you have a very young sludge, what if you have a very old sludge, what if your TSS is lower on one day than the other. All of these variables can change the test results in spite of the fact that you are using the same volume of MLSS for each test. The same volume of MLSS does not mean the same quality or number of bugs in the 2 mls for each test. Some days you might get better activity and other days less depending upon the current status of your bacteria in your system.

Ok, so how do you get around that - there are companies that manufacture BOD seed tablets. These BOD seed tablets are a blend of specialized microbial cultures in an easy-to-use capsule. They are designed to provide a uniform standard for the degradation of both industrial and municipal waste in BOD_5 analysis.

B.O.D. seed increases accuracy and consistency in B.O.D. testing and eliminates costs associated with collecting and maintaining an acclimatized seed. Each B.O.D. seed capsule contains specialized microbial cultures to provide a broad range of organisms suitable for most types of industrial and municipal wastewater. One capsule of B.O.D. seed provides enough acclimatized seed for up to 250 B.O.D. tests daily, at a cost of pennies per test and in strict accordance with "Standards Methods" as established by the U.S.E.P.A.

This is an easy way to eliminate any inconsistencies in testing.

All BOD is not the same! What do you mean by that? Well most municipalities have the same flow and the same influent BOD typically 100-150 ppm. Therefore, there should never be problems? Yet why do they have problems?
Ok, suppose it is a big football weekend, everyone has pizza and beer this weekend. Next weekend, everyone is out cleaning their yards, using fertilizer, and weed killer, washing off their utensils, the following weekend, everyone is cleaning their carpets! The total load to the plant may still have been 150 with dilution factors, but some of the major chemistry that is coming down may have changed. There may be more grease, which can cause filaments or biocides, surfactants, etc. All BOD is not the same! What would you rather eat, pizza and ice cream or broccoli? It is the same to the bacteria, some compounds are very quickly digested, others take more time, or multiple strains of bacteria to break apart the compounds and work on only a small piece at a time.

All BOD really means is the total amount of oxygen consumed, not whether it is simple sugars, or hard to degrade ring compounds! A BOD at a food plant with 150ppm has totally different chemistry than a BOD of 150ppm at a chemical plant.

Also remember that BOD is typically a 5-day test. If you have a holding time of 24-48 hours, you may be in trouble if it takes up to 5 days to degrade all the organics!

Think about what you are doing at your plant, what you are trying to accomplish, what you are measuring and are these tests relevant. All these variables may make things easier to run your plant.