Upgrading of Low-boiling fraction bio-oil derived from past pyrolysis at the nitrogen condition

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Nowadays, more and more people have been focused on the renewable and clean energy. By this lots of company is using fast-pyrolysis bio-oil, this is relatively cheap and easy to make the bio-oil. But it has many problems to substitute recent fossil fuels as transportation. Because of it's low heating value, high acidity, corrosiveness (past pyrolysis bio-oil has high oxygen, water composition), high total acid number and very viscid characteristic. Therefore we need oil-upgrading process to use this as a transportation fuel. We have divided the fast pyrolysis oil into high boiling fraction and low boiling fraction. Some process about high boiling fraction has been developing. But there are small amount of research about low boiling fraction. So we have focused on the upgrading process about low boiling fraction. Also we use nitrogen gas condition instead of hydrogen gas, to consider the economic feasibility.