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pH, Conductivity and Buffer Capacity of Six Iranian Wood Species

HASAN SADEGHIFAR*, RAMIN VEISI†, YASHAR EINOLLAHI†,
JAVAD SEIFOLLAHI and ABDOL GHAFFAR EBADI‡
Department of Chemistry, Islamic Azad University, Ghaemshahr Branch, Ghaemshahr, Iran
E-mail: hsfar93@gmail.com

The pH, conductivity and buffer capacity of wood and bark of six Iranian woods investigated. The mean pH values of *Fagus orientalis* and *Acer laetum, Alnus subcordata* are about 7. The mean pH values of *Quercus castaneaefolia* and *Carpinus betulus* are about 5.0-5.5 in different part of stem. *Parotia persica* has lowest pH less than 5. Buffer capacity values of *Acer laetum* is more than 0.45 and for other woods are less than 0.4. Mean pH for each six tree bark is higher than stem pH. Bark pH for *Acer laetum, Fagus orientalis* and *Alnus subcordata* are *ca.* 7 and for other woods are *ca.* 5. *Acer laetum* has high conductivity and buffer capacity. *Quercus castaneaefolia* has minimum conductivity and buffer capacity.

Key Words: pH, Conductivity, Buffer capacity, Iranian wood.

INTRODUCTION

The acidity of a material may be assessed by pH and buffer capacity. The pH value of wood or woody materials is an important criterion of its suitability for various applications[1]. The ability of the adhesive to cure on a substrate depends greatly on the condition of the surface. Since the rate of cross linking of most thermosetting adhesives is pH-dependent, these adhesives will be sensitive to the pH of the substrate[2]. In order for the resin binders to cure properly in the board furnish, the appropriate acidity must be established[3]. The cure of urea-formaldehyde resins is accelerated in an acidic environment. However most of the phenolic resins used for wood-based composite require a base environment for cure. The formulation of most adhesives is adapted to the acid range of the substrate and a wide deviation of this value will create difficulties in providing a superior adhesive bond. Thus, pH value of any material intended for the manufacture of an adhesively-bonded composite has to be known. Resistance of wood or woody material to the change in its pH level is called the buffer capacity. According to Maloney[3], a larger quantity of acid catalyst is required to decrease the pH to the level for an ideal resin cure when the material possesses a high buffering capacity. A single species of wood or any woody material that possesses high variability of buffering level could be an important issue, but becomes a critical factor when multiple species are used.

†Department of Chemistry, Islamic Azad University, Chalus Branch, Chalus, Iran.
‡Department of Biological Sciences, Islamic Azad University, Jouybar Branch, Jouybar, Iran.

EXPERIMENTAL

Six Iranian wood was purchased from Iranian north forest. A disk of each wood cut from 1.3 m hight of each tree. Cross section of each disc divided in three section in radial direction and labeled inner, middle and outer part of stem. Each part chipped seprately with a laboratory chipper and placed in a conditioning chamber for several weeks. Moisture content was monitored until equilibrium was reached (temperature = 20 ºC and relative humidity = 65 %). Each specimen was ground to pass a 425 mm (40 mesh) using a Wiley milling machine.

pH and conductivity value measurement: The procedure of pH and conductivity determination was adapted from the cold extraction method for H^+ concentration (pH) of paper extracts, TAPPI T 509 om-83[4]. The specimen (1 g ± 0.01 g) was then transferred into a 100 mL beaker and distilled water (pH 6.7) was added until the specimens were wet. Distilled water was added again to bring the total volume to 70 mL. The mixture was stirred well and allowed to soak for 1 h at room temperature. A battery powered pH meter and conductivity meter (Jeneway) was used for the measurement. The pH meter was calibrated using three standard solutions, pH 4.0, 7.0 and 10.0. The electrode of the pH meter was submerged into the unfiltered mixture and the pH value was recorded.

Buffer capacity: The procedure for buffer capacity determination was adapted from the method used by Maloney[3] and Borden Chemical Inc.[5]. Thirty grams of dry fibers were soaked in 400 g of distilled water (20 ± 1 ºC) for 0.5 h. The mixture was stirred several times during the soaking. The liquid was then separated using filter paper and 150 g of the liquid was placed in a beaker. Temperature was maintained at 21 ºC. The pH meter was calibrated using the same method as was used for determining the pH value and the original pH value was recorded. Titration was done using 0.01 N HCl. The pH value was recorded after each acid addition. Addition was made at an increment of 0.5 mL up to 10 mL and then with increments of 1 mL thereafter. A magnetic stirrer was used to mix the titration solution. The milliequivalents (N × mL) of acid needed to change the pH to 3.5 was calculated as the buffer capacity of woods.

Statistical test: One-way analysis of variance tests performed on the pH value, conductivity and buffer capacity.

RESULTS AND DISCUSSION

pH value: Table-1 shows the result of pH for different part of each six tree stems. Analysis shows that there was significant differences in pH value between trees (1 % level of probability) but there is not differences in pH value between cross section of each stem (1 % level). The mean pH values of *Fagus orientalis* is more than 7 and for *Acer laetum* and *Alnus subcordata* this value are more than 6.8. The mean pH values of *Quercus castaneaefolia* and *Carpinus betulus* are *ca.* 5.0-5.5 in difrent part of stem. *Parotia persica* has lowest pH less than 5.

TABLE-1
pH VALUE IN DIFFERENT PART OF STEM

Species	pH Value in different part of stem		
	Inner	Middle	Outer
Acer laetum	6.82	7.47	6.80
Quercus castaneaefolia	5.5	4.91	5.25
Parotia persica	4.48	4.78	5.10
Fagus orientalis	7.22	7.18	6.68
Alnus subcordata	6.89	6.05	6.68
Carpinus betulus	5.58	5.52	5.06

Conductivity value: Table-2 shows the result of conductivity for different part of each 6 tree stems. Analysis shows that there was not significant differences in coductivity value between trees (1 % level of probability) but there was significant differences in conductivity value between cross section of each stem (1 % level).

TABLE-2
CONDUCTIVITY VALUE IN PARTS OF STEM

Species	Conductivity value in parts of stem		
	Inner	Middle	Outer
Acer laetum	8.87	7.34	8.28
Quercus castaneaefolia	5.15	8.00	8.94
Parotia persica	6.74	6.81	6.41
Fagus orientalis	5.89	5.31	5.13
Alnus subcordata	5.41	4.66	5.85
Carpinus betulus	5.17	5.39	7.52

Buffer capacity: Table-3 shows the result of buffer capacity for different parts of each 6 tree stems. the mean buffer capacity values of *Acer laetum* is nore than 0.45 and for other woods are less than 0.4. with increasing of mean pH values of woods, buffer capacity increase too.

TABLE-3
BUFFER CAPACITY FOR DIFFERENT PARTS OF EACH SIX TREE STEMS

Species	Buffer capacity in part of stem		
	Inner	Middle	Outer
Acer laetum	0.56	0.380	0.415
Quercus castaneaefolia	0.28	0.440	0.400
Parotia persica	0.53	0.350	0.350
Fagus orientalis	0.24	0.175	0.230
Alnus subcordata	0.21	0.230	0.230
Carpinus betulus	0.31	0.370	0.320

pH, conductivity and buffer capacity of bark: Mean pH for each 6 tree bark is higher than stem pH (Table-4). pH for *Acer laetum, Fagus orientalis* and *Alnus subcordata* are about 7 and for other woods are about 5. *Acer laetum* has very high conductivity and buffer capacity. *Quercus castaneaefolia* has minimum conductivity and buffer capacity. All woods with higher pH value, conductivity value have higher buffer capacity.

TABLE-4
pH, CONDUCTIVITY AND BUFFER CAPACITY OF WOODS BARK

Species	Bark		
	pH	Conductivity	Buffer capacity
Acer laetum	6.80	29.32	1.620
Quercus castaneaefolia	5.25	7.00	0.350
Parotia persica	4.87	13.50	0.625
Fagus orientalis	6.68	7.28	0.625
Alnus subcordata	6.68	11.57	0.455
Carpinus betulus	5.06	16.39	0.665

Conclusion

Measurment of pH, conductivity and buffer capacity of wood and bark of six Iranian woods showed that the mean pH values of *Fagus orientalis* and *Acer laetum, Alnus subcordata* are about 7. The mean pH values of *Quercus castaneaefolia* and *Carpinus betulus* are about 5.0-5.5 in difrent part of stem. *Parotia persica* has lowest pH less than 5. Buffer capacity values of *Acer laetum* is more than 0.45 and for other woods are less than 0.4 with increasing of mean pH values of woods, buffer capacity increase too. mean pH for each 6 tree bark are higher than stem pH. Bark pH for *Acer laetum, Fagus orientalis* and *Alnus subcordata* are *ca.* 7 and for other woods are *ca.* 5. *Acer laetum* has high conductivity and buffer capacity. *Quercus castaneaefolia* has minimum conductivity and buffer capacity.

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